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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, ST. AUGUSTINE, TRINIDAD.

MECHANICAL TRANSPORT.

THIS year the British Railways are celebrating their centenary. In view of the fundamental importance of the railway to modern commerce it is with no little amusement that one reads of the fantastic fears with which contemporary thought viewed their introduction. Huskisson stated in the House of Commons that, "The beauty and comfort of country gentlemen's estates would be destroyed by the railway. Was the House aware of the smoke and the noise, the hiss and the whirl which locomotive engines passing at the rate of 10 or 12 miles an hour would occasion? Neither the cattle ploughing in the fields or grazing in the meadows could behold them without dismay. Leaseholders and tenants, agriculturists, graziers and dairymen would all be in arms. . . . It would be the greatest nuisance, the most complete disturbance of quiet and comfort that the ingenuity of man could possibly invent." Although a statesman of vision in other directions, Huskisson failed to foresee the day when agriculturists both in the temperate and tropical zones would be almost completely dependent upon the railway for marketing their produce. Other responsible mouthpieces of public opinion predicted that vegetation would cease wherever the railway passed; cows, even, it was said, would cease to yield their milk in the neighbourhood of one of these infernal machines. Towns, particularly in regions served by the canals, did their utmost to oppose the construction of railways. Northampton congratulated itself on making the railway avoid the town by five miles. In view of the stagnation among vast regions of the tropics caused largely by the lack of adequate railway facilities this attitude appears pathetically ironical. Shortly, however, the ruthless trend of economic factors was to break down the hysterical opposition of vested interests and ill-informed public opinion. Within a few decades the three great land Empires of Germany, Russia and the United States of America had been created, largely as a result of the introduction of a network of railways. Both man and material became gifted with a new mobility making localisation of industry and division of labour feasible propositions. Administration over scattered areas became really effective for the first time owing to the rapidity with which troops could be rushed to disaffected regions. Slavery in the continental areas was abolished only when mechanical transport provided a substitute for the primitive method of head porterage. Commerce throughout the world was quickened and new Colonial values were created. Railways enabled the vast hinterlands to be developed with the result that islands declined in comparative importance and continental areas sprang into prominence. Colonies regarded as worthless burdens at the beginning of the nineteenth century were hailed as valuable assets at the end. Emigration was stimulated since it was no longer regarded as exile,

What the railway accomplished in the internal organisation of countries the steamship effected in international trade. Distance was annihilated, regularity ensured, and time made a significant factor. Goods were moved in bulk and with a rapidity undreamt of a few years previously. Countries, as well as towns, began to specialise and the United Kingdom became the workshop of the world—a situation rendered tenable only by the fact that other countries were able, and willing, to supply her factory operatives with food and raw materials and to accept manufactured goods in exchange.

The twentieth century has witnessed the introduction of new means of locomotion in the motor car and aircraft. In the more highly developed countries motor transport has tended to restrict the development of the railway and in some cases has played the rôle of an active competitor. In the tropics motor lorries have been complementary, acting as feeders for the railways. In certain areas, particularly in tropical Africa, where the existing trade does not warrant the construction of a railway, and where the construction and maintenance of roads in first class condition is not an economic proposition, the motor car, fitted with a flexible track, offers a solution to a problem which has hitherto prevented comprehensive economic development.[1] Aircraft may now open up a new vista of commercial development. At present they are in the embryonic stage but there is every possibility that within a very short period the whole Empire may be linked up by air mails.

The tropics, though the last to feel the stimulating influence of the railway, have been no less fundamentally affected. Pioneers were able to penetrate past the fever-stricken coast line to the healthier hinterland. Vast numbers of porters were released for agricultural and other pursuits. Order was established and peaceful penetration and development begun. Food and raw materials were needed for the industrial centres of Europe and the United States and these the tropics were now in a position to supply. The introduction of the steamship and the railway, in fact, mark the beginning of agriculture in the continental tropics. One form of transport, the motor car, is wholly dependent upon the tropics for the supply of one of its essential raw materials, rubber. With the unlocking of the tropics by mechanical transport vast quantities of raw materials and food could be placed upon the markets of the world, and as prices fell so family budgets and diets expanded. Some of the best brains of Europe began to emigrate to the tropics and modern science and implements were applied to tropical agriculture. European capital followed. So great has the demand for tropical products become that European countries are beginning to devote funds for the prosecution of tropical agricultural research. The present trickle of money must inevitably develop into a steady stream as the value of the work becomes more fully recognised. Europe is undergoing a painful period of re-organisation and in the prevailing confusion it is extremely difficult to unravel the tangled threads of economic movements. One thing at least is certain, namely that ten industrial centres, in their search for markets, food, and raw materials, must depend more and more upon the tropics. The Right Hon. L. S. Amery, Secretary of State for the Colonies, has expressed the opinion that the tropics are on the eve of a period of rapid development. All this hinges upon transport. This much is made clear from the illuminating report recently published by the East African Commission. The report says, "European Government in East Africa may be said to have commenced seriously with the opening of the present century, and the chief agency whereby development has been accomplished, and will in the future be further accomplished, is the construction of railways.... Railways, and railways alone, provide an adequate means of perennial transport and communication.... The potential riches of East Africa lie in the cultivation of the soil. There is a vast area of the most wonderful land, adequately watered and capable of yielding economic crops of almost all tropical, sub-tropical, and temperate varieties." The Commissioners propose that a loan of £10,000,000 should be devoted to the development of transport in East Africa. This region is not alone in its need for an extension of transport facilities. West Africa is another region where additional railways are an immediate necessity; British Guiana, too, languishes because of the absence of the railways and labour necessary to open up the interior. Tropical agriculture, European industries and mechanical transport are interdependent. Transport forms the key to the whole problem and we hope that the second century in the history of the railways will usher in a period of intensive and extensive railway construction in the tropical portions of the British Empire, for in this way alone can the ground be prepared for the agricultural development which the temperate zones anxiously await.

(1) This question is dealt with more fully on another page.

"HANDBOOK OF BRITISH HONDURAS, 1925."—pp. 460 with map and many photographic illustrations. West India Committee, obtainable from the Crown Agents for the Colonies, 4, Millbank, Westminster, S.W., 1. Price 5/-.

The last official Handbook of British Honduras was published thirty years ago since when many important changes have taken place within the Colony. The present Handbook was prepared by Messrs. M. S. Metzgen and H. E. C. Cain at the request of the Governor, Sir Eyre Hutson, K.C.M.G. The compilers have drawn freely upon existing publications dealing with the Colony and have received valuable assistance from the Heads of the various Government Departments. The assistant Conservator of Forests, Mr. C. Stocker, contributes valuable information upon the Colony's staple industry, timber, which is illustrated by a number of photographs. Those interested in British Honduras will find it a veritable mine of information.

TROPICAL RESEARCH.

The Amani Institute.

H. MARTIN LEAKE, M.A., SC.D. (Cantab.), F.L.S.

"IN our opinion there are few subjects of greater importance to the development of the East African territories than scientific research." With this opening sentence the Commissioners commence the chapter on Scientific Research and the Amani Institute, in their report presented by the Secretary of State for the Colonies to Parliament.* Research here is interpreted in its widest sense; the desirability of the "purely cultural pursuit of knowledge" is recognised as of the greatest importance but it is also recognised that Governments, situated are as those of East Africa, "legitimately desire to devote their attention to those opportunities of science from which they can reasonably expect an early return for their expenditure." The breadth of view exhibited by the Commissioners is illustrated by their reference to anthropology—a subject not usually considered by Governments as worthy of study for its intrinsic economic importance. Yet if a mandate is accepted as a trust for the inhabitants, development must be evolutionary and it can only truly be so, if a full understanding of the starting position is obtained.

Scientific research, in its more restricted sense is dependent on facts but the collection of such facts is not frequently entrusted to the departments which are primarily concerned with the conduct of research. Thus accurate meteorological data are of prime importance for a research department dealing with agriculture in an Agricultural area yet their collection, if not their tabulation, can rarely be undertaken by such a department. This again is a position which the Commission recognises.

The territories with which the report deals are essentially agricultural and Research in the restricted sense may be directed to two objects; it may be directed to improvement of the system of agriculture generally, whether that involves the system of tillage or the nature of crops grown. It may, too, be directed to the physical improvement of the agriculturist, for little progress can be made without a healthy working population. In other words, research may be definitely agricultural or it may be medical. Owing to the exigencies of the circumstances, prominent among which are the appalling ravages of sleeping sickness, more attention has, perhaps, been devoted to research of the latter type than of the former, while the encroachment of the tsetse fly into tracts where cattle have established a position of economic importance has brought into prominence the necessity for veterinary work. In spite of this fact, and in spite of the devotion of the officers, the field for medical and veterinary research is so vast that the ground is little more than broken. The tsetse fly is still far from under control and an expansion of work in both branches is urgently required if progress is to be made. But if this is the case with medical and veterinary research, agricultural research occupies a still more unfortunate position. Chemical investigation was commenced in Nairobi but the activities of the Chemical Research Department was devoted to public health and toxicological work for the police and the Department subsequently dissolved. Agricultural Departments it is true have done an immense amount of valuable work but they have been under-staffed and their efforts concentrated in directions other than research.

The position is summed up by the Commissioners in the following sentences which are so important that no apology is required for quoting them *in extenso.*

"Small departments (such as exist in East Africa) cannot hope to offer the prospects necessary to attract the best type of research workers. There can be no adequate means of checking the quality and quantity of the work performed. There can be no opportunity of transferring men whose idiosyncrasies may make them unsuitable as colleagues in a particular department. Above all, those qualities which make for enthusiasm in research are rare and should be given an outlet other than that provided by promotion to executive or administrative departmental posts. It is, indeed, rare that, where a research department is placed under the control of a many functioned department, the best results are obtained."

Is it possible, it may well be asked, for any single colony or even any group of colonies, to carry the weight of a department such as is here accepted as the essential for research if any hopes of results of economic importance are to be entertained? Must not such institutions be carried on a still wider, and Imperial, basis? And does not the history of the Amani Institute support this view? This institution, established by German enterprise and situated in Tanganyika, is, in spite of the enthusiasm shown by the authorities of that territory and in spite of efforts at home, "for all practical purposes lying derelict," being too great a burden on local resources, while corporate action on the part of those territories which it might serve has proved impossible. The history of Amani since the territory was mandated to Great Britain only too clearly proves the difficulties that beset the path of research. It is hardly possible to blame a Government that is barely solvent for scrutinising closely any proposal to spend money outside its boundaries; such a Government must ask itself what practical benefit it will derive from such expenditure and it will estimate these benefits from a purely local aspect. The full benefits of research are not measurable within such narrow limits.

The College of which this Journal is the organ is established on such an Imperial basis and its function is dual. On the one hand it has an educational, and on the other a research, side;

* Report of the East African Commission Cmd. 2387, Price 3/6.

though it has hardly existed long enough to make its mark in the latter sphere of activity. Tropical agriculture, however, has two aspects dependent on climate, and the relatively moist conditions of an insular position differ from those of a seasonal rainfall which characterise continental areas; in addition to much that is applicable to both, each has its special problems. This College is situated on an island and it is well adapted to give a balanced education in tropical agriculture and to study general questions but it is hardly in a position to study those problems which are incidental to a continental atmosphere. No institution can, in fact, meet the requirements for agricultural research for the entire tropical portions of the Empire. For the present this College will satisfy for an indefinite time to come, the educational requirements of the Empire in this direction but the re-establishment of Amani as recommended by the Commission for a research station can only be viewed in one light. It will be a sister institution between which and this College none but the most cordial relations could possibly exist.

It is earnestly to be hoped that Amani will be restored to the position it occupied under the German regime for it has become a matter in which the credit of the British Empire is at stake. The following words, taken from the report itself, summarise this aspect:

"Bearing in mind the great efforts that are being made by the United States of America, France and Belgium, we cannot but feel that more imagination is needed if our tropical possessions are to rank with those of other nations as regards scientific development."

The Rt. Hon. L. S. Amery, Secretary of State for the Colonies, speaking as the guest of the West Indian Club, stated that he marked the beginning of a new era in the West Indies when Mr. Chamberlain set up the Imperial Department of Agriculture. That Department had now given birth to a sturdy offspring, The Imperial College of Tropical Agriculture—a College which he believed was destined to bring about great results, not only to the West Indies, but also to the whole Empire. "We at the Colonial Office," continued Mr. Amery, "intend to make the fullest use of it. We intend to send our future agricultural officers to learn there. If it is good enough for us, and those who are concerned with cotton growing, it ought to be good enough for any firm with business in the West Indies. I hope that the West Indian business world, which has already done so much to support the College, will continue their efforts and place it on an adequate foundation."

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THE POWER ALCOHOL PROBLEM.

PROFESSOR F. HARDY, M.A.

[*The following article, dealing with a subject of paramount importance to tropical agriculturists, is based largely on a review by Dr. Herbert Langwell (a well-known authority on cellulose fermentation), which appeared in the first number of the new British Journal "The Industrial Chemist," February,* 1925.]

1. Introduction.

THE production of alcohol as a cheap source of energy has exercised the ingenuity of scientists for a considerable time; nevertheless, the solution of the problem has not yet proceeded beyond the initial stages. The use of alcoholic beverages is gradually declining. In consequence, many distilleries will be constrained either to manufacture products other than potable alcohol, or to produce alcohol entirely for industrial use. Thus, many British distilleries are already making yeast as chief product, relegating alcohol to the position of by-product. Were it possible to reduce the cost of manufacturing either main-product alcohol or by-product alcohol to a figure commensurate with the cost of petrol, no doubt alcohol would at once become an important fuel for internal combustion engines.

2. Raw Materials.

All the raw materials so far employed for the manufacture of alcohol in distilleries, are composed chiefly of sugar or of starch, both important food stuffs. It would be unsound, however, to grow food crops as prospective sources of fuel alcohol, especially in countries where high-rented arable land forms the main agricultural asset. In other words, sugar and starch can scarcely be spared in amounts large enough for fuel production, and the small amounts that can be spared are too expensive for this purpose. Obviously, then, a cheaper source of alcohol must be found. Molasses is immediately suggested, and has, of course, much to recommend it, but improved sugar refinery methods, and the discovery of other uses for molasses, are gradually utilizing all the profitable resources. Even if this were not so, and even if the entire world production of molasses were available for producing power alcohol, not more than 200 million gallons of fuel could be obtained from that source. When this figure is compared with the present day consumption of petrol of over 3,000 million gallons, molasses does not appear to be a particularly promising raw material. It should also be remembered that fully fermented molasses solution contains only a small percentage of alcohol, and that a considerable amount of heat energy is required to separate its volatile components by distillation. This imposes serious technical difficulties, and increases the cost of production, especially in regions where fuel is expensive.

So far, *coal* and *cellulosic substances* appear to be the only suitable raw materials available for the large-scale production of power alcohol. We may discuss their relative merits in turn.

3. Coal as Source of Power Alcohol.

Coal has the advantage of cheapness ; its stores are also well-nigh inexhaustible. Estimates have shown that serious shortage of coal need not be feared for at least a thousand years. Moreover, feasible methods of converting coal into alcohol have already been elaborated as a result of intensive research in recent years. Two processes have so far been tried on a fairly large scale, but neither of them can as yet be described as commercially successful. There is reason to believe, however, that the inherent difficulties may one day be overcome. The two processes are (1) the *carbide-ethyl alcohol* process, and (2) the *water gas-methyl alcohol* process. The first consists in converting coke into calcium carbide, from which acetylene is prepared. Acetylene may then be converted into ethylene, ethyl hydrogen sulphate, and finally, ethyl alcohol, or it may be converted into acetaldehyde and thence to ethyl alcohol. A Swiss firm some time ago contracted with the Swiss Government to supply alcohol made by the carbide-acetaldehyde process, but the contract had soon to be broken, because the process turned out to be too expensive. The second process (methyl alcohol from water gas) is described in " *Chemical Notes* " appearing at another place in the current issue of this Journal ; it need not be reconsidered here. Suffice it to say that the cost of production of industrial methyl alcohol has already been brought down to such a low figure, that the product may soon actually become a serious rival of petroleum fuel.

4. Cellulose as Source of Power Alcohol.

Cellulosic substances are available in prodigious quantities, both as waste material from cereal crops (straw), and as natural vegetation in tree forests, bamboo groves, papyrus swamps, grass pampas and the like. For example, it has been estimated that 600 million tons of straw and cereal husks are produced every year, and that some 35,000 square miles of papyrus swamp occur in the Sudan alone, yielding about 20 million tons of cellulose per annum. There is no fear of exhaustion here. The difficulties of rendering vegetation available for fuel alcohol production are, firstly, that the raw material is very bulky and therefore costly to handle, and secondly, that, so far, no entirely satisfactory commercial method for converting cellulose into alcohol has been devised. No doubt this is largely due to the fact that the necessary incentive to detailed research is not yet forthcoming, because of the fact that petrol is still reasonably cheap, and that present supplies adequately meet all demands. Fermentation is the only process that has been examined at all intensively. Two methods for fermenting cellulose have been elaborated, namely, (A) the indirect method, in which cellulose is first converted into glucose sugar, which is subsequently fermented with yeasts, and (B) the direct method, in which certain specific micro-organisms are allowed to effect the break-down of cellulose into products containing alcohol.

(A) The indirect method of cellulose fermentation.

The cellulosic materials are treated with 40 per cent. hydrochloric acid to effect hydrolysis into glucose. The main technical difficulties attending the use and recovery of acid of such high concentration appear to have been largely overcome. The process is only suited, however, to the treatment of wood, but even then, unfortunately, the pentosan component of wood, comprising about 20 per cent. of its weight, is completely lost as furfural. On the other hand, straw and similar materials that contain smaller amounts of lignin and pentosan, give poor yields of glucose on acid hydrolysis, and are best treated by the direct fermentation process.

(B) The direct method of cellulose fermentation.

So far, no organism has been found which will rapidly attack *lignified* celluloses such as wood, jute and certain other plant fibres, under anaerobic conditions, unless the material be first freed from combination with lignin. Fermentation by organisms that operate under aerobic conditions, transforms ligno-cellulose into water, carbon-dioxide and humic substances chiefly, and yields little or no alcohol. On the other hand, straw and similar *non-lignified* cellulose materials can be caused to yield, by a certain direct fermentation process, products such as alcohol, acetic acid, butyric acid, lactic acid, methane, hydrogen and carbon-dioxide. Of these, alcohol, acids and methane, are produced in greatest quantity. By suitable further treatment, these may be converted into a type of alcoholic liquid fuel which is even more satisfactory than alcohol itself. The output may reach as high as 80 gallons of fuel per ton of cellulosic material when circumstances are favourable, but, assuming only 40 gallons yield per ton, an annual world's output of 24,000 million gallons of alcoholic fuel from 600 million tons of waste cereal cellulose could theoretically be realized, and this is more than six times the present day consumption of petrol.

The utilization of waste cereal straw for the purposes of manufacturing liquid fuel would in no way interfere with food supply ; indeed it would tend to reduce the price of food, because it would enable the farmer to sell his produce more cheaply. Nor need it interfere with the employment of waste cellulose for the manufacture of ordinary or of synthetic farm-yard manure, because the supply of raw material, if carefully conserved, would be amply sufficient to meet this additional demand as well. In tropical countries, raw material could be obtained in unlimited abundance, but the technicalities involved in alcohol manufacture are not so easy to overcome in undeveloped regions as they are in industrial centres that are already well established.

5. The Value of Alcohol as Fuel.

Alcohol possesses many advantages over petrol when used as fuel in internal combustion engines. Although not so volatile as petrol, alcohol may easily be improved in this respect by converting

a part of it into ether or acetone. Alcoholic fuel obtained by the direct fermentation process, already contains acetic acid, which may be converted into acetone. Alternatively, methane, which is liberated as another by-product in this process, may be converted into methyl alcohol, and added to the fuel to increase its volatility. As regards calorific value, petrol is superior to alcohol, but this advantage is never fully realized in the petrol engine, because premature explosion usually prevents the employment therein of compressions higher than 90 lb. to the square inch. On the other hand, a mixture of alcohol vapour and air may be compressed to 200 lb. per square inch without causing pre-ignition. If, therefore, an engine be designed with a high compression ratio for use with alcohol, it might show so much higher efficiency, that the inferior calorific value of alcohol will be balanced by the increased power developed. Under ideal test conditions, petrol at a compression ratio of 4·55 to 1·00, gives an efficiency of about 30 per cent., whilst alcohol under similar conditions, excepting that the compression ratio be increased to 7·50 to 1·00, gives an efficiency of 40 per cent. The lower compression ratio is approximately the maximum for petrol, whereas for alcohol, the higher compression ratio is well within the limits of safety. The petrol engine has been evolved for specific use with petrol, but in spite of this fact, alcohol can be rendered suitable for use in existing engines merely by mixing with it 10 to 30 per cent. of ether, acetone or methyl alcohol, and by enlarging the size of the carburettor jet. Doubtless, if alcohol is ever used in large quantities as motor fuel, new types of engines, working at high compressions, will be designed. Finally, alcohol requires relatively lesser amounts of air for complete combustion than does petrol. Thus, a litre of explosive petrol-air mixture contains only two-fifths the volume of fuel vapour that the same quantity of explosive alcohol-air mixture contains, so that a greatly increased power is actually realized at each ignition. This increase in power may be 20 per cent. at ordinary compression, and 40 per cent. at higher compressions, in suitable alcohol engines. By reason of these, and of many other minor advantages, alcohol is a really excellent fuel for internal combustion engines, and, provided the great manufacturing difficulties associated with its large-scale production, whether from coal or from cellulose, can finally be overcome, alcohol is likely to replace mineral oils more and more completely as the earth's available stores of liquid fuel become exhausted.

Two students from South Africa are expected to enter the College in October next as nominees of the Empire Cotton Growing Corporation. These candidates have been working under plant breeders at Barberton and Rustenburg respectively, and will eventually take up posts in the Cotton Division of the South African Department of Agriculture.

SILVICULTURAL RESEARCH.

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Acting Conservator of Forests, Trinidad and Tobago.

IN a previous article in this Journal the importance of Forests in relation to Agriculture was emphasized. Both the indirect utility of Forests, such as their effect on the climate, the conservation of soil humidity and water supply, the prevention of landslips and erosion on mountains and hillsides, the provision of shelter-belts, the utilisation of poor Agricultural lands for their improvement, and their direct utility in the production of cheap timber and other Forest Products for the Agricultural community are closely allied with the interests of Agriculture. It may, therefore, be advisable for the Agriculturalist to appreciate something of the aims of the Forester and the problems with which he is confronted.

The first step in the scientific management of any Forest area is the preparation of some form of Working Plan; whatever the primary *raison d'être* of its reservation as Forest, still it may be brought under a Working Plan with the object of its eventually attaining the production of its maximum yield commensurate with the achievement of the objects of Management. Several windbelts, for example, the primary object of which is the protection of Agricultural lands, may be grouped together under a simple Working Plan leading to profitable timber production combined with the fulfilment of their protective duties. Again, Mountain Forests, reserved primarily for the prevention of erosion and the safeguarding of the Agricultural plains below, may, under suitable Working Plans, become productive; the Silver Fir Forests of the Auvergne Mountains in France provide an excellent example of this.

Without Working Plans, Forests reserved for timber production tend to remain chaotic; under Working Plans they can in time attain close to the Forester's ideal—Normality. A normal forest is one which contains a normal growing stock, a normal increment, and a normal distribution of the Age classes; by the latter is meant "a series of age gradations so arranged that at all times when cuttings are to be made woods of the normal age are available of sufficient extent and in such a position that no obstacles to their cutting exist." Such a normality ensures a sustained yield from the Forest, and an equalised annual or periodic yield, whichever is required, can be provided for. In other words it is the essence of the aims of scientific Forest management.

An average Working Plan is prepared for a period of, say, 10 years, after which it will undergo revision. It is divided into two parts—the first part containing a description of facts as they exist, together with a collection of all the data of value available, and the second part containing

comprehensive prescriptions as to the method of management to be followed in the future, and estimate of the yield, a financial forecast, and provision for the control and execution of the plan.

The prescriptions as to the method of management to be followed in the future lay down, amongst other things, the species or mixture of species to be grown, the silvicultural system or systems to be employed, the rotation to be followed and the general lines of treatment in respect of methods of formation, regeneration and subsequent tending and thinnings.

The prescriptions of a Working Plan, once sanctioned, must not, except under very special circumstances, be departed from; it follows, therefore, that they must be based on sound principles of silviculture and must not contravene them. The point to be emphasized is that the principles of silviculture are in turn based on the silvicultural characteristics and requirements of trees: where, therefore, information is lacking as to the silvicultural characteristics of the species to be grown, it is impossible to apply the principles of silviculture correctly.

In Europe and India, where Forests have been under scientific management for many years past, such information is readily available; years of experiment and research have resulted in an abundant acquisition of data, which have been duly recorded in standard works such as Professor Troup's Silviculture of Indian Trees. In colonies, however, where Forest Departments are, comparatively speaking, in their infancy, the reverse is the case: there have been neither time nor staff in the past for the all important work of research, and local knowledge stops short after supplying information as to the local names of the various species, their value in the local market, and possibly the soils to which some of them are best suited. It follows, therefore, that in such cases, before Working Plans can be prepared, much knowledge must be acquired.

The more important Silvicultural characteristics of any species are comprised in the locality and soil conditions to which it is most suited, the light requirements essential to its optimum growth, its reproductive powers, its suitability to be grown pure or mixed (and if the latter with what species), the methods by which it can best be regenerated, the shape and development of its root system and crown, its susceptibility to injuries from external influences such as wind, insects and disease, its rate of growth, its age of maturity and its utility. Prescriptions involving the choice of species and future method of treatment demand a knowledge of these characteristics, if successful results are to be obtained.

Consider the light requirements of a species alone. Successful natural regeneration from parent trees cannot possibly be obtained in the face of ignorance as to the amount of light demanded both for the germination of the seed and the subsequent growth of the seedlings. Some species are light demanders, others are shade-bearers: further in Tropical Forests an admission of over much light results in a riotous crop of weeds, vines and worthless shrubs, which will kill out the seedlings of the valuable trees. Knowledge therefore as to the amount of light which will permit of the growth of the valuable seedlings without an excessive accompaniment of weeds and vines is essential. In artificially formed plantations the light requirements of the various species must be known, before a decision as to the correct choice of mixtures can be arrived at: in general, light demanding species are underplanted with shade bearers for the adequate protection of the soil and to lower the costs of tending by the prevention of excessive weed growth.

The problem presented by the lack of knowledge of the silvicultural requirements of indigenous species can, indeed, be solved by the introduction of suitable exotics in respect of which such information is available. This, however, is shirking the question; indigenous species usually will grow as well and often better—if we know how to grow them: and they should be grown if they are of value.

Again the universal adoption of the system of clear felling and artificial replanting would go far to ease the difficulties of the problem. This system, however, while being less rigid than others in its demand for a full knowledge of the silvicultural characteristics for fair success to be obtained, yet presents many drawbacks:—It is expensive: it affords no protection to the young crop: it exposes the soil to rapid deterioration, especially in dry climates, in that it leaves it open to the injurious effects of sun and air currents; finally it utilises none of the help which nature gives the Forester if he possesses the skill to make use of it.

The correct solution of the problem lies, as already indicated, in silvicultural research; this may be carried out somewhat on the following lines:—

A. Experimental 1-Acre Plots.

(*i*) *Without Field Crops.*

An accessible area should be chosen in the Forest to be regenerated in the future under a Working Plan, and a number of 1-acre plots marked out thereon. A scheme for the regeneration of these plots should then be drawn up embracing varieties of methods of formation, variations of light from full light to full shade, varieties of species and mixtures considered likely to suit the locality and soil conditions, different methods of sowing and planting and different planting distances. This will afford an abundant field for observation, comparison and deduction. Subsequent weeding, cleaning and filling up of blanks should, of course, be carried out.

Of controlling importance is the record of the experiments in order that none of the data presented be overlooked. Such a record should

commence with a general description of the whole area, comprising its locality, altitude, aspect, slope, exposure and any other locality conditions of importance. This should be followed by a detailed description of each experiment plot, showing its soil, and drainage conditions: the preliminary works of formation carried out, with the cost: the amount of light: the species chosen, and method of regeneration employed with its cost. Thereafter, every year the results obtained should be recorded, followed by deductions as to the advantages or disadvantages of planting over sowing, the requirements of each species for light, the suitability of each species to the soil and to be grown pure or mixed and so on.

From the data thus obtained, a preliminary list of the silvicultural characteristics of each species will emerge—to be amended and elaborated by further experience. Initial deductions should be of a tentative character, as hasty conclusions are often falsified by later experience.

(*ii*) *Growth of Field Crops with seedlings.*

The combination of Forestry with the growing of field crops opens up a further field of experiment. Such a course, when practicable, is of advantage to the Forester, in that the proceeds of the sale of the field crop reduce the cost of formation of the plantation: further, the growth of the field crop between the rows of seedlings keeps down weeds and lowers the costs of tending. In Burma the Taungya system for the formation of Teak plantations has been almost universally employed for many years past, the field crop most commonly used being rice.

Many field crops, however, may prove injurious to the tree seedlings. Some may overtop the young trees during the first year, which results in loss of growth: others may kill out young light-demanding species by the excessive shade they cast, or whip the tender leading shoots of the young trees and cause considerable damage. In the second year of growth a field crop may again be advisable: if so a change of crop may be indicated, another and less exacting kind being required.

Experiment should, therefore, be made on unshaded experimental plots with various forms of field crops and the results carefully compared.

B.—Experiments with Natural Regeneration.

Besides experimental plots artificially regenerated, study must be made of the abilities of the various species to regenerate themselves naturally. With this end in view mature parent trees which will bear good seed should be located in the Forest and clearings made round them embracing various conditions of light and shade. The resultant growth of seedlings and weeds should be observed and noted, and, in particular, an effort made to determine the minimum amount of light under which the seed of each species will germinate and the subsequent seedlings thrive. It is of very common occurrence to observe the area round a seed tree covered with young seedlings three to four inches high and a few months later to find all those seedlings killed out either by excessive shade or by "drip" from the overhead cover.

C.—Experiments with Advanced Growth.

Patches of advanced growth of natural regeneration may frequently be observed in a Forest: their persistence usually indicates shade-bearing capabilities on the part of the species concerned, but in general such advanced growth will be found to be thin and whippy and partially suppressed. Here overhead cover should be lightened and the response, if any, of the advanced growth to the better light conditions noted. Some of the advanced growth should be coppiced to the ground and the results noted.

D.—Experiments as to Rate of Growth.

By the methods outlined above a working knowledge of the majority of the silvicultural requirements of the various species—at any rate in their early stages—may be fairly speedily acquired. In the case of rate of growth, however, the acquisition of the necessary data will require at least one rotation for the reason that no mature trees *grown under scientific forest conditions* are available.

It is indeed of some value to the Working Plans Officer to fell a mature tree of a species which presents clearly marked annual rings, and to make a stem analysis therefrom in order to fix a provisional rotation for that species. But the story told by the annual rings of a tree grown under natural conditions would not coincide with that which would have been obtained from the same tree had it been grown under scientific forest conditions, where the young trees are grown close together to force each other up in the struggle for light and existence—in order that the maximum rate of height growth and clean branchless trunks may be obtained—coupled with careful thinning later to produce girth increment without undue breaking of the canopy.

The rotation chosen for any species may vary in accordance with the objects of management: it must, however, be based on the rate of growth of that species. If the objects of management, for example, consist of the production of the greatest return of volume, the rotation must coincide with the year in which the mean annual increment culminates: but the latter cannot be calculated unless data as to the rate of growth are available.

The only method here is to measure annually all the trees in a number of marked sample plots of say, 1 acre each in the plantations and experiment plots and to record annual height and diameter increments of every tree so measured. From the data so obtained graphs can be prepared showing the rate of growth of each species for a given quality of locality: and—more important still,

since the growth of the crop as a whole is the deciding factor—yield tables and volume tables can be built up.

To summarise briefly: the essence of scientific Forest Management lies in Working Plans: the preparation of Working Plans presupposes a knowledge of the silvicultural characteristics and requirements of the species to be grown: where, therefore, this knowledge is lacking, it must be acquired by silvicultural research. The original forests of the world are rapidly becoming exhausted; in another century or so timber will probably be as much a "crop" as cotton or rubber are now; and it is clear that on the successful solution of some of the problems outlined above will depend the future supply and cheapness or otherwise of Timber.

IMPERIAL PREFERENCE.

THE grant of an Imperial Preference on British tobacco, currants, dried fruits, wines and sugar has been ratified by the Imperial Parliament. One of the most significant features of the debate in the House of Commons was the support accorded by certain members of the Liberal and Labour Socialist parties, indicating, we hope, that the question of Imperial Preference has been raised above questions of party politics.

Mr. Lees-Smith (Labour Socialist), in moving an amendment which would have had the effect of rejecting the proposals, urged that a preference on such things as dried fruits would make it extremely difficult to abolish the duties altogether at a late date and so establish a "Free Breakfast Table." The preference would be equivalent to bestowing a subsidy upon the "employers and producers overseas." Lieut.-Colonel Guinness, Financial Secretary to the Treasury, replied that the preferences would develop alternative sources of supply within the Empire and that eventually there would be a substantial gain to the British consumer.

At present the Empire produces only 7 per cent. of the tobacco consumed within the United Kingdom. It was announced that the Imperial Tobacco Company is prepared to make the whole of the Preference effective by putting on the market a high quality Empire produced tobacco at ½d. per ounce cheaper than any now sold.

While the preference on sugar is not likely to benefit the consumers immediately it will have the effect of stimulating production within the Empire and ultimately, with increased supplies, bring some relief to the consumer. Sugar estates could not be developed if preferential duties had to be passed annually. Mr. Churchill referring to the stabilisation of the sugar preference for ten years stated that, "Nothing can bind the future of any British Parliament or Legislative Assembly, but a promise solemnly made in these circumstances is a factor which every parliament which had regard to national continuity would take into consideration." The amendment was rejected by 277 votes to 93.

EDUCATION IN EAST AFRICA.

REPORT PREPARED BY THOMAS JESSE JONES, Ph.D., *Chairman of the second African Education Commission.*

A STUDY of East, Central and South Africa under the auspices of the Phelps Stokes Fund in co-operation with the International Education Board. pp. xxvii+416.

Much has been written in recent years on the subject of education and the angle from which the question is now viewed is very different from that which was customary even a short time ago. The classical literary education common in the early Victorian period was adapted to the limited community which alone received much education. The extension to a larger section of the community which took place later in the same period was literally an extension; an opening up of facilities to classes who had hitherto possessed none, for the same literary type of education. The mention of names like Birkbeck and Toynbee, however, is a sufficient indication that the universal suitability of this form of education was even then called in question. Since that time vast strides have been made and it is now generally recognised that education must be adapted to the future walk in life of the educated. The extension of educational facilities which now apply to all classes and almost all communities, has, however, progressed at a pace more rapid than practical recognition of this more recently accepted proposition; as a consequence the adaptation of educational method to the needs of the individual's sphere in life takes the form of the reversal of an hitherto accepted educational policy.

This is a truth which is probably universal though it is less apparent in countries like America where, owing to the comparative modernity of the community, old and deep rooted custom has not had to be broken down. The development of democratic ideals and the numerical superiority of the "classes" have caused a swing of the pendulum in favour of utility or vocational education which is likely to overwhelm the older form in countries which have little or none of the inertia imparted by historic custom. This movement receives a further stimulus in countries such as those with which the report deals. The first educational contact is, in these cases, almost invariably effected by the missionary and it must almost inevitably be with the masses. Then, following the introduction of settled government under the British flag, comes the demand for a subordinate administrative service to which the literary education is an open sesame which, in the past, has proved irresistible. The line of evolution is clear; mission educational enterprise among the masses; literary education to create a public service among these same masses and lastly, with the recognition of the fact that all cannot enter the public service, the swing of the pendulum has diverted education of the masses into practical channels.

As a recognition of this concept of education the work under review is an exceptional document; "the main emphasis of the report falls upon the need for an education adapted to the conditions under which the majority of the African people live to-day." That agriculture is the key to that material development which must take place *pari passu* with the educational uplifting of the peoples is fully appreciated; in the words of the report "the first step towards agricultural instruction as an educational aim is a development of real appreciation of its importance in Africa." That this recognition is of wider import and, in fact, world wide is also fully recognised for "there is probably no more vital problem of education than that of helping society the world over to understand the primary importance of agriculture to human welfare." The development of character, the equipment of the individual to fill his sphere in after life are the key notes of the report and combined with this is the recognition that a small niche in the Government organisation is no outlet for the vast majority. So far the report is admirable. But is this the whole story? A nation or community is built up of units but, unless those units are welded together, the corporate body will be effete. Units of agricultural production based on the cultivator and his family require to be welded together if they are to reap the reward of their productive effort. Such units tend to be uneconomic; they require capital to develop and they require capital to organise the disposal of their excess produce. But the handling of capital involves organisation of a different type and a relatively small, but proportionally effective body of men; and if this organisation is to be truly indigenous and not to be of foreign origin, and this is essential to the interpretation of a mandate to develop a country in the interest of the inhabitants, there arises for a relatively small class of the population the need for a separate education which will fit these select individuals for their special rôle in the communal complex.

It is here that this report appears to lack definiteness. The progress of the primitive races must be evolutionary in character; the racial, or tribal, organisation must be accepted and used as a starting point for better things and how can this be better accomplished than by training the chiefs along lines which will fit them to fulfil the rôle indicated? They are numerically small but their tribal influence gives them an effectiveness out of proportion to their numbers. In these points they fulfil the requirements for the directing body whose presence is essential.

The point appears to be recognised for it is stated that "the millions of native people must have native leaders." But the entire argument on Higher Education is directed to leaders in the sense of professional men, doctors, teachers, and the like and the misconception culminates in the sentence "sound policy requires that the lower schools must be taught with a living consciousness of the right of all pupils to opportunities for advancement to the top of the system."

Literally this is indisputable but experience elsewhere indicates that "right" to be so universally interpreted as a right to an advancement to the top of the system that the statement of right even qualified as it is is dangerous. A careful perusal of the report discloses no recognition of the need of a special training for the leaders in the sense above indicated yet without it progress must be revolutionary rather than evolutionary. The history of India sufficiently indicates the dangers of such an omission. The literary education imposed by Macaulay on India was primarily directed to the provision of a subordinate clerical service. From that educated group have arisen a body which, owing to the wonderful intellect of the Indian, has obtained a position of marked influence in the direction of that country's progress. But education of that type passed by the real leaders of the country, the landed proprietor and the trader and the consequence is a vocal element with little true stake in the country and a material development falling far short of the moral requirements. Hence the unrest which so unfortunately characterises that country at the present time. Here too in recent years the pendulum has swung and vocational education looms large in all discussions but educational policy is still directed almost entirely in the interest of the masses. Education still remains communally unbalanced.

Admirable as is the report on the subject of the education of the masses, its adoption in practice can only lead to a repetition of India's troubles unless the complementary field of education be simultaneously entered.

H. MARTIN LEAKE.

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TRANSPORT IN TROPICAL AFRICA.

AT a recent meeting of the Royal Society of Arts, Mr. R. H. Brackenbury delivered a lecture of great interest and importance on "Transport in Tropical Africa." The most striking feature of the problem is the very large economic gap between the primitive methods developed by the natives themselves and the highly specialised railway systems laid down by the governing European Powers. With head transport, as the quantities of produce to be moved increase the cost of transport per unit also increases, whereas the reverse is the case with the railways. To carry 100 tons of produce a month over a distance of 100 miles absorbs the energies of 2,000 porters who might be more usefully employed in agricultural, mining or pastoral pursuits. Apart from this economic objection, men are not available in such large numbers, and intolerable delay, thefts, desertion, sickness and damage to loads make this form of transport inefficient, wasteful and extravagant.

On the other hand it is a very dubious venture to construct a railway for carrying quantities at present so small. Light railways cannot be built for less than £5,000 per mile—the railways of Nigeria cost £11,000 per open mile, and in the Gold Coast £17,000—involving interest at 6 per cent. per annum, plus 4 per cent. for maintenance and replacement. A railway carrying less than an average of 1,000 tons of goods or produce a month over its whole length is likely to prove an uneconomic proposition. Hence the gap between the maximum practical limits of head porterage and the minimum economic possibilities of railway transport, a fact which probably accounts in large measure for the delay in the full development of the almost limitless resources of Tropical Africa.

There arises the necessity for considering other means of transport for filling this gap. Pack donkeys carrying a load of 100-120 lb. would be an improvement, particularly for traversing the shorter distances between the place of production and the collecting depôts of the traders. With wages at 9*d*. a day head transport costs 3*s*. per ton-mile. The cost of pack donkeys is a little less, but not only does the cost rapidly increase as the quantities become important but there is also the fact that pack transport is definitely excluded from those broad belts of territory dominated by the tsetse fly. Ox waggons, typical of South Africa, can transport loads of 5 tons or more at 9*d*. to 1*s*. per ton-mile, but this system too is rendered impracticable on account of pests and diseases.

Mr. Brackenbury considers that the construction of macadamised roads, capable of carrying heavy motor transport, must remain an impracticable dream owing to the prohibitive cost of maintenance under tropical conditions. Although it is impossible to make roads to suit the vehicles there is every hope of making vehicles to suit the roads, or rather the lack of them. Practical vehicles with a flexible track have been designed which can be propelled with no greater consumption of power than a wheel lorry of the same size on a hard road. While embodying the familiar caterpillar track of the Tank it will be realised that these commercial vehicles differ in other material characteristics. It is more important that they should be able to pass fully laden over a soft track without cutting it up than to be able to push down a house; to pull a heavy load up a steep grassy slope without skidding, than to take a six-foot trench, and to register a low road resistance than to be impervious to rifle fire. To the war-time Juggernaut cost per ton-mile was a minor consideration, but to the commercial vehicle it is of supreme importance.

Sir Frederick Lugard in opening the discussion stressed the importance of arterial railways. It has been estimated that produce worth £30 a ton would cost the whole of that amount to convey it 200 miles by head porterage, which means that it is useless to produce commodities for export at this distance from a port. African rivers are exceedingly unnavigable, being generally impeded at their mouths by bars, and at a comparatively short distance from the coast by rapids. Striking figures are available regarding development due to railways. In Uganda the output of cotton four years ago was 40,000 bales; for the present year it is expected to be 200,000. The Nigerian railways this year expect a gross revenue of £2,000,000 and net revenue of £1,000,000. The main problem is to feed these railways. Roads are impracticable. Money should first be spent on bridges and culverts, with some cleaning of bush between them, and on vehicles adapted to using such a track and which, instead of cutting it up would improve it.

Mr. G. H. Baillie, stated that the Empire Cotton Growing Corporation was investigating the possibilities of track vehicles and emphasized the necessity for low initial and running costs particularly with regard to seasonal crops such as cotton. Mr. P. H. Johnson (Joint Managing Director of the Roadless Traction, Ltd.), drew attention to the fact that just as conditions off the roads were more varied than conditions on them, so there would probably be a greater variety of roadless vehicles than of road vehicles. Sir Humphrey Leggett, in winding up the discussion, urged that £100,000 of the £10 million which it was proposed to spend in East Africa on railway construction should be set aside to test, in every way, vehicles capable of solving the cross-country transport problem. We congratulate Mr. Brakenbury upon his happy combination of practical details with a firm grasp of the wider economic problems.

C. Y. S.

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

MYCOLOGICAL NOTES.

Research on Diseases of Plants.

IN the two preceding numbers of this Journal reference was made to the behaviour of some varieties of sugar-cane towards the infectious Mosaic disease. It is now well known that this disease is not restricted to sugar-cane but has been found under field conditions on Maize, Sorghum and a considerable number of weeds of the grass family (Gramineae). Its primary source of infection appears to be sugar-cane and the dominant transmitting agent, the corn aphis. A large number of unrelated cultivated plants have been found, during recent years, to be affected by similar infectious Mosaics which in most cases are known to be transmitted by insects mainly hemipterous. Like a number of infectious diseases of animals and man such as small-pox, measles and rabies, the causal agent has not been recognised; it is commonly referred to as a "virus" a term which is non-committal as to its nature. The Mosaics appear to be the most important members of a larger group of so-called "degeneration" diseases which have come to be regarded within recent years as the most serious factors depressing the yields of some major crops including the potato. The Mosaic of the true grasses has attracted much attention in the United States, in part on account of the rapidity of its spread on sugar-cane in Louisiana, the losses inflicted by it on that crop in Porto Rico, its present menace to the great cane industry in Cuba and perhaps not least to its possible extension northwards on maize, the major crop of the United States. Another disquieting aspect of the situation is the transmissibility of the Mosaic of one plant to quite unrelated species; one investigator claims, for instance, that he has infected the tomato with Mosaic from sugar-cane under certain experimental conditions; similar observations raise the question as to whether there is but one Mosaic which may pass over ultimately to all cultivated plants bringing with it an enduring and appreciable depression of crop yields generally. Among the problems of the day calling for fundamental investigation on a broad basis the Mosaics hold therefore a prominent position. Research of this character on the Mosaics and Yellows of plants is, in fact, already in progress at the Boyce Thompson Institute for Plant Research, Yonkers, New York, which was opened officially in September, 1924. A very generous endowment by the founder, an American of outstanding insight and large foresight, has resulted in provision of the finest available equipment for modern botanical research under conditions of controlled light, heat humidity and carbon dioxide of the air. The staff organisation is in six divisions each with a head and a director over all; the divisions are Physiology, Pathology, Bio-chemistry, Micro-chemistry, Physical Chemistry and Morphology. Each division is undertaking its own special problems but there are certain notable projects demanding close co-operation of all sections. The outstanding project of that kind at present is fundamental research on the Mosaics and Yellows of plants. Pathologists, bio-chemists, physical chemists, micro-chemists, an entomologist and a protozoologist are working together on this problem, an intensive concentration of specialised effort comparable only with such as came into being during the war for the solution of urgent problems. The remarkable equipment is due to the initiation of the director Dr. William Crocker and it is of interest to note that the head of the Pathological Division is Dr. L. O. Kunkel whose work with the H.S.P.A. in Hawaii on the Mosaics of sugar-cane and other plants is well known. The opening of the Institute was notable for the finely worded and inspiring speaking, in which Americans excel, of a number of prominent research workers in pure and applied botany. An important feature is the ample provision made, alongside the permanent staff, for the use of the unique equipment by outside research workers, an opportunity which, it is hardly necessary to say, will not be restricted to citizens of the United States. It is also proposed to establish a system of advanced research fellowships. In this connection the director in the course of his speech said:—"It is believed that a continual flow of temporary younger appointees through the Institute will avoid stagnation and fossilisation. This is a condition that frequently occurs in research institutions which lack the rejuvenating influence that comes from association with alert and ambitious young minds. Co-operation with practical and scientific plant research institutions might act also as an anti-fossilizer."

Control of Plant Diseases by Dusting.

THE spraying of orchard and truck crops with fungicides against a number of the more serious diseases caused mostly by parasitic fungi, has been for many years an economic practice on a large scale in temperate countries under conditions of intensive cultivation. In the tropics, however, where planting is extensive, and the crop small in size and of relatively low value opportunities for the economic control of diseases by such systematic direct measures have been very restricted.

In Kenya Colony the spraying of coffee with Bordeaux mixture (or a variation in which carbide is substituted for quicklime) has been an economic practice for a number of years against leafrust and recently "Bordeaux" was used by coffee planters in India on a large scale for the control of a dieback and anthracnose, which had become epidemic. The same spray fluid is used also as a matter of regular practice in Java and Sumatra to control Phytophthora in tobacco seed beds. There can be little doubt, however, that attempts to control fungous diseases of tropical crops by direct measures would be more frequently made if the application of fungicides could be done with less expenditure of effort, skill and money. It is

therefore of much interest to note that during the last four years dusting has been found an efficient substitute for spraying in the control of a number of fungous diseases of orchard and truck crops in temperate lands especially in North America. Although more material is required than for spraying the amount of labour is much reduced as the handling of water is entirely eliminated; a larger area can be covered in the same time, less skill is required for preparation and application and the equipment is less costly. These advantages would appeal with special strength to planters in the tropics where much land in permanent crops is on steep slopes or is more or less heavily trenched.

According to Professor H. H. Whetzel, a leading Plant Pathologist in the United States, dusting with fungicides has proved to be an effective control for a number of fungous diseases of peach and apple orchards and of truck crops such as potato (late blight due to Phytophthora infestans), celery, melons, &c., and he believes that it has a very promising future and will gradually displace spraying for the control of many diseases. The two fungicides mostly used at present are ground sulphur and copper-lime dust. The copper-lime dust, a mixture of dehydrated or mono-hydrated sulphate of copper and hydrated lime was devised by Sanders and used by him with marked success in large scale experiments in apple orchards in Nova Scotia where it is now employed by the more progressive practical growers. The effectiveness of sulphur appears to depend largely on the fineness of the particles and grinding cannot attain the utmost in that respect. Colloidal sulphurs are now available for spraying but have not yet been produced at an economic cost for dusting. The dusts are not so adhesive as the sprays and no very effective sticker has been developed so far capable of being used with dusts. Dr. Whetzel feels confident, however, that these difficulties will be evercome as soon as the conservatism of the manufacturers of materials and apparatus and of plant pathologists is broken down by a realisation of the advantages of dusting and its wide range of application over spraying. He refers to very promising results on an experimental scale in the control of cereal rusts with ground sulphur, and encouraging results with orchard crops by substituting ground copper carbonate for the copper-lime dust.

In conclusion he says "Cotton dusting has developed by leaps and bounds in the last five years, the most recent development being the use of aeroplane dusters. I understand that commercial contracts for aeroplane dusting of cotton fields at $1.00 per acre for next season are now being made in one section of our southern cotton growing region. Plans for using aeroplane dusters in the control of forest insects are under consideration in Western Canada. Aeroplane dusting of the great cereal fields from Northwest and Western Canada are in the offing. I predict that we shall witness within the next decade an expansion in dusting compared with which the use of spraying during the past ten years will appear small and insignificant."

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Bud Rot of the Coconut Palm in Porto Rico.

A disease of young and bearing coconut trees, in which the youngest visible leaves rapidly wilt and die whilst the rest of the crown appears quite healthy, has been recorded from many tropical countries. The dead or dying heart leaves can be pulled out and show a soft evil-smelling rot of the broken stalk. If the central shoot or central column of an affected tree is split open the primordial tissue and growing point at the apex of the stem which constitute the bud proper, will be found, usually, fully soft-rotted and a semi-liquid malodorous mass. The growing point being destroyed the tree makes no new growth and dies off. This disease has been carefully investigated in India, the Philippines and Jamaica and the same species of Phytophthora has been proved to be the cause in each of those countries. The fungus was isolated from the affected tissues, grown in pure culture, and inoculated on to healthy trees which developed the same symptoms of disease. The mycelium of apparently the same fungus has been found in the buds of trees affected in the same way in the Seychelles, Fiji, Trinidad and the Virgin Islands, indicating a very wide distribution of the casual agent in the tropics. Until very recently it was believed that this budrot did not occur in Porto Rico. It is now reported to be present in epidemic form on the West Coast of that island, C. M. Tucker, the Plant Pathologist of the Federal Station, Mayaguez, has investigated the outbreak and shown that the casual agent is the same species of Phytophthora as in India, the Philippines and Jamaica.

It is known that coconut palms have been and are dying with similar symptoms in Cuba and there can be no doubt that when the disease in that island is investigated the cause will be found to be the same. As the bud proper is already destroyed when the first symptoms of the disease are detected treatment has to be directed to prevention of infection. Nothing very definite is known in regard to the best prophylactic measures beyond the prompt destruction by fire of the diseased crowns. The disease is closely associated with conditions of high humidity due to rainy periods, sheltered damp situations or defective soil drainage.

S. F. A.

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TROPICAL WORLD NOTES.

Mozambique.

The *Times* recently issued a comprehensive and well illustrated supplement on Portuguese East Africa tracing its development both political and economic from the time of the first occupation by Europeans. The principal native grown crops are maize, millet, ground-nuts, sweet potatoes, beans, rice, sesame, manioc and tobacco. Most of the native production is grown for home consumption. About 10,500 tons of ground-nuts and 2,265 tons of sesame were exported from the State-administered districts in 1922, practically all being native grown.

Maize growing on large scale European estates is confined almost entirely to the Mozambique Company's territory in which the annual production is now about 50,000 tons while the exports from the State-administered districts did not exceed 250 tons in 1922. With the provision of additional transport facilities the production could be considerably increased. There is considerable scope for an increase in the production of cotton and tobacco. Fruit growing—bananas, citrus, fruits, pineapples—offers considerable possibilities provided adequate and cheap shipment can be arranged by steamers equipped with cold storage. In some of the more elevated districts European fruits can be grown successfully but at present these areas are remote from the centres of population.

Cattle breeding, as elsewhere in East Africa, is confined to those areas free from the ravages of the tsetse fly. The bulk are raised in the neighbourhood of Lourenco Marques where there were 220,000 head in 1922. Ticks constitute the main drawback. Sheep are not numerous but goats and pigs are extensively kept by the natives.

Sugar enjoys pride of place among the plantation industries, the chief centre being the lower Zambesi Valley where the Sena Sugar Estates, Ltd., cultivate a large acreage and own four large factories. One factory, the Luabo, produces 20,000 tons of sugar per annum and is designed with a view to eventual expansion to a capacity of 40,000 tons. In 1924 the four factories produced nearly 40,000 tons of sugar but it is expected that this figure will shortly increase to 60,000 tons. Uba is chiefly grown. The next most important sugar organisation is the Companhia Colonial do Buzi possessing two factories with an aggregate capacity of 16,000 tons of sugar per annum. The erection of a third factory is contemplated. Other large estates exist and expansion is retarded solely on account of the low prices realised for sugar.

Coconuts rank second in importance among plantation industries. The area to the North of the Zambesi appears best suited to the palm. The Zambesi Boror Company claims to possess more coconut trees than any other single company in the world. Exports of copra and other oilseeds from the State-administered districts exceeded 30,000 tons in 1923.

Venezuela.

Venezuela is stated to be taking a keen interest in the prospects of cotton growing. The President of one State had recently announced that money prizes will be given to cotton growers who produce the largest and best crop within this district during 1925. It is pointed out that climatic conditions are ideal for the culture of cotton in many parts of Venezuela, especially in the States of Carabobo and Aragua. The character and abundance of the labour supply, nearness to the large consuming centres of the country, coupled with low freight costs and richness of the soil, are among the important factors which should make this section the principal cotton-growing centre in Venezuela.

Chile.

The future of the nitrate industry of Chile is causing some anxiety. At the moment the industry is in a flourishing condition, the maximum producing capacity of all the nitrate officinas being roughly four and a half million tons per annum whereas last year's production was 2,400,000 tons. The deliveries during the first quarter of the present year amounted to 460,000 tons compared with 330,000 tons last year.

The main cause for anxiety lies in the increasing manufacture of artificial fertilizers particularly by Germany and America. Both the Chilean Nitrate Producers and the Government are fully alive to the danger and recognise that the existence of the industry depends upon its ability to compete with the artificial fertilizers by reducing prices. The Government of Chile is, to a large extent, financed by the export tax on nitrate which at present is levied at the rate of about 51*s*. per ton. The producers contribute a proportion of their profits towards a propaganda fund which is also subsidized by the Government. The producers are anxious to secure a reduction of about 7*s*. per ton on the export tax when they would also be willing to make a similar reduction in their figures. This would have the effect of reducing the present prices by about 15*s*. per ton and by stimulating consumption would, to some extent, diminish the net loss to the Government and the industry.

The correspondent of the London Chamber of Commerce Journal views the recent action of France with considerable apprehension. France has specifically included German artificial sulphate and fertilizer in the list of materials and articles to be taken in payment of reparations by Germany and, in addition, has imposed a heavy import duty on the natural nitrate with a view to protecting and fostering an artificial fertilizer industry of her own. If other countries follow suit the nitrate industry of Chile, and with it the basis of the country's prosperity, will be ruined. Consequently in fixing the prices for the next six months the Association of Nitrate Producers is making every effort to reduce prices to a level which will enable the industry to meet this new competition successfully.

Fiji.

Cotton cultivation in Fiji is rapidly assuming some importance as a minor agricultural industry in Fiji. During the period of high prices following the American Civil War both European planters and native communities grew cotton on a fairly extensive scale. With the return of normal competition the industry appears to have declined into relative insignificance. Since 1918 high post-war prices have again stimulated interest. The *Agricultural Circular* issued by the Department of Agriculture, Fiji, states that seeds of the Sea Island variety were imported from Barbados in 1922 and distributed to planters. In 1923, 101 bales containing 14¾ tons of lint were exported and in 1924, 27¼ tons. Advances, varying according to quality of seed cotton, are guaranteed by the Government and any balance remaining is distributed when the prices realised have been ascertained. The British Cotton Growing Association has undertaken the marketing of the crop while the Empire Cotton Growing Corporation has offered to supply ginning machinery to the value of £500 repayable over a period of three years. Cultivation is principally carried on by East Indians on small areas so that no reliable information is available regarding costs of cultivation, picking, &c. The average value per lb. of lint sold during 1923 was 24·9*d.* per lb. and in 1924, 35*d.* per lb., the increase in price being due largely to the greater proportion of A Grade cotton. The average yield of seed cotton at the Lautoka Experimental Station for the years 1906-15 was 528 lb. per acre, while in 1924 the average yield of Indian and other cultivators was 424 lb. per acre. An increased yield is anticipated as the result of added experience. The Government controls the collection and distribution of seed, all importations being prohibited except by written permission of the Superintendent of Agriculture. Ratooning is prohibited and all plants must be uprooted and burnt in October after which no planting is permitted for a month. Pests have given very little trouble.

Belgian Congo.

M. Leplae, Director-General of the Ministry for the Colonies gave a comprehensive resumé of cotton growing in the Belgian Congo before the Association for Colonial Development. He stated that cotton to the value of 600,000,000 f. was purchased annually from the United States and India. In view of the decline in the exportable surplus from America it was essential that cotton production should be stimulated within the Belgian Colonies in the same way as in the British Empire. It was not until 1913 that an American expert was sent out to Maniéma to carry on systematic experiments at the farm at Nyangive. During the war the cotton was sent to the United Kingdom and utilised mainly in the manufacture of explosives. Two up-to-date ginning plants were purchased from America and established at Kibombo and Lusambo. Smaller plants have since been erected nearer the plantations.

At the request of M. Franck, Minister for the Colonies the Cie. Cotonnière Congolaise was formed by a group of the leading financial and textile concerns. The Company now plays a leading part in the industry and four other large groups have recently been established. In 1915-16 12 metric tons of raw cotton and 4 of ginned were produced. By 1918-19 the production had risen to 450 metric tons of raw and 150 tons of ginned cotton. In 1923-24 the crop amounted to 10,300 metric tons of raw and 3,433 tons of ginned cotton. The ultimate aim is to produce all the cotton necessary for the Belgian factories, namely 250,000 bales. A few years ago the prospects of attaining such a large crop were very remote but M. Leplae now considers it well within the bounds of possibility. One of the greatest difficulties to be overcome is the small return to the grower in comparison with other native products. A big road building scheme is expected to solve the main transport problems.

Brazil.

In spite of the disasters which have overtaken the Brazilian coffee industry, and the low prices ruling, few people, apparently, have taken any practical steps to diminish their dependence upon this single crop. A prominent cotton expert stated before the "Natural Agricultural Society" in Brazil in 1921 that, "the area suitable for cotton cultivation in Brazil is larger than that of the United States and the conditions of climate and soil obtainable in Brazil are probably more favourable to cotton cultivation than any other part of the world." While considerable difficulties exist there is no doubt that a considerable expansion of the cotton industry would be a great benefit to the country.

Yet the correspondent of the "*Manchester Guardian Commercial Supplement*" reports that very little progress has taken place. The small planters still remain faithful to coffee and new areas are continually being opened up in the belief that the coffee industry is a sound investment, while cotton is a precarious and speculative venture.

Hopes at present are centred upon British and other syndicates which have secured considerable concessions and are planting cotton on a fairly extensive scale. It is believed that the small planters will be induced to take an interest in cotton if the larger companies are successful.

Pests have recently caused considerable damage and apparently inadequate measures are being taken to cope with them.

In 1913-14 459,486 bales each of 500 lb. were produced. In 1924-25 the crop is expected to be 582,746 bales of which about 428,215 will be consumed within the country, leaving 154,531 for export.

India.

Mr. H. A. F. Lindsay, C.B.E., I.C.S. (Indian Trade Commissioner in London), in a communication to the *London Chamber of Commerce Journal*, states that the Indian rice crop of 1924-25 amounted to 31 million tons, against 28 million tons in the previous season. Owing to the adverse weather conditions early this year, the sugar-cane crop fell from 3,317,000 tons to 2,920,000 and the wheat crop from 9,747,000 tons to 8,802,000 tons. Last season's jute crop was officially estimated at 8,045,000 bales ; it is too early yet to say how the new jute crop will turn out, but it is known that the acreage under jute is more extensive this year than last, and official estimates put the new crop at 10 million bales, should weather conditions continue satisfactory. With regard to cotton a considerable increase occurred from 5,162,000 bales last year to 6,058,000 bales this season. Complete statistics have now been received of the output of the Indian oil-seeds. The ground-nuts crop increased from 1,086,000 tons last year to 1,407,000 tons ; the sesamum crop from 441,000 to 501,000 tons ; rape and mustard from 1,152,000 to 1,173,000 tons ; and finally, linseed also showed an advance from 462,000 tons last year to 541,000 tons this year. These statistics show an all-round advance in the production of the principal classes of oil-seeds in India. Interest at present centres in the future course of the monsoon. A shortage of rain during the early months of this year was followed by heavy showers in May ; and the monsoon is reported by an official telegram dated June 2nd to have broken at Bombay. The forecast is that " the monsoon rainfall of this year is likely to be normal or deficient in the Peninsula, normal or in excess in North-East India, and deficient in North-West India."

Gilbert and Ellice Islands.

The Gilbert Islands were proclaimed a British Protectorate in 1892 and the Ellice Islands in the same year. The jurisdiction of the Resident Commissioner of the Protectorate was extended to Ocean Island by a proclamation of 1900. They were annexed in 1915 and became known as the Gilbert and Ellice Islands Colony from 1916, Ocean, Fanning, Washington and the Union Group of Islands being included within the Colony in the same year. Christmas Island was also included in 1919.

The total population in 1921 was 29,897 of whom 264 were Europeans (only 74 being females), 348 Asiatics, and 29,285 Pacific Island Natives (14,205 females).

The exports of phosphate amounted to 189,475 tons valued at £246,318 of which 116,475 tons were exported to Australia. The corresponding figures for the previous year 1922-23 were 134,350 tons valued at £201,525. The exports of copra declined from 5,928 tons valued at £89,396 in 1922-23 to 3,716 tons valued at £45,951 in 1923-24. Two and a half tons of Shark Fins valued at £276 were exported.—(*Colonial Report No.* 1246.)

RHODESIAN NOTES.

MAJOR H. G. MUNDAY,
Chief Agriculturist.

(*The following is the second of the series of periodic notes which Major H. G. Munday, Chief Agriculturist and our Honorary Correspondent for Southern Rhodesia, has been good enough to promise us. The first report appeared in our issue for May* 1925, *Vol. II. No.* 5, *p.* 104.)

The rainy season closed with an average precipitation over the whole country of anything from 20-30 inches above the normal. The yields of the staple crops—which at one time promised to be exceptionally good—have appreciably been decreased, particularly from the areas of shallow, sandy soil. The output of maize is expected to exceed that of last year, but not to reach the maximum achieved in 1922-23. Tobacco, on account of the constant rains, has cured out rather light and papery, but the colour generally is good. Cotton has suffered also, especially at the higher altitudes, but at lower elevations the yield and quality will be satisfactory. The winter thus far has been very mild, and this coupled with the large amount of moisture still in the soil has caused the cotton crop to ripen very slowly. At the date of writing (June 27th) many growers have hardly taken more than their first picking.

Bindura, in the Mazoe Valley, recently saw the opening by His Excellency the Governor of the first Cotton Show held in Rhodesia. Entries were numerous, and the quality of the exhibits was thought very highly of by the Rhodesian Cotton Specialist of the British Cotton Growing Corporation and by the several representatives of Liverpool cotton buying firms who are now in the country watching developments and purchasing cotton. The Show synchronised with the official opening of the Bindura Cotton Ginnery.

The entries of produce at the Bulawayo Agricultural Show which takes place next week are said to be exceptionally numerous and much interest is evinced in the quality of cotton which Matabeleland will produce this year. Cotton will form one of the most important features of this Agricultural Show and of the Salisbury Show commencing July 6th, both of which are being opened by His Royal Highness the Prince of Wales.

Turning to livestock the most striking development of the past year has been the marked expansion in the dairy and poultry industries. The production of butter, milk, cheese and eggs shews a great advance over previous years and the dairy industry in particular will be further stimulated by the provision recently made by Government for short period loans to farmers for the purchase of dairy stock.

A constant stream of new settlers seems now directed towards Southern Rhodesia. Numbers of new farms are being taken up and large areas are being cleared and brought under the plough with a resulting strong demand and greatly improved prices for transport oxen. The indications point to an era of steady progress accompanied by increased prosperity.

COCOA IN NIGERIA.

The Improvement of Quality.

C. J. LEWIN,
Deputy Director of Agriculture.

CLIMATIC factors limit the production of cocoa in Nigeria to a coastal belt roughly 150 miles wide, and economic considerations further confine cocoa planting to certain areas within this belt. Since 1900 there has been a rapid and steady growth from 200 tons to 37,200 tons (1924) in the annual exports. There is little doubt that this rate of increase will be maintained for a time, as considerable areas planted during the boom years succeeding 1917 have yet to come into full bearing. It is difficult to arrive at any estimate of the ultimate possibilities, as the capacities of many large areas are still quite unknown. The plantations, which are entirely in the hands of native farmers, are small, rarely exceeding two or three acres, and generally speaking ill kept, in view of which the freedom from disease is remarkable. Fermentation is rarely practised and drying is often imperfect, with the result the quality of Nigerian Cocoa is poor. The small holdings, together with the lack of transport facilities, render the farmer peculiarly dependant on itinerant middlemen. The price the latter is prepared to pay is still further lowered by the rapid fluctuations of the market.

With a view to improving the quality of the cocoa exported, and to obtain for the producer himself the premium he earns, the Department of Agriculture started, in a tentative way, a scheme of co-operative fermentation in 1922. Demonstration cocoa houses were erected in the Oyo province and cocoa brought in by the farmers was fermented and sold in bulk by the Department, the proceeds being divided among the participants proportionately. Since then the scheme has been extended to the Abeokuta, Ijebu-Ode and Ondo provinces. The project is still in its infancy and it would be premature to dilate on the prospects of future extension. The peculiar difficulties encountered in work of this kind in Nigeria do not lend themselves to brief explanation, but taking them into consideration, the progress achieved is most gratifying. In order that the process may not prove formidable to farmers curing on their own account, the method employed is of the simplest compatible with efficiency. Cocoa is fermented in baskets of local manufacture, each containing about 4 cwts. of wet beans. The drying trays are also constructed locally. The expenses are partly borne by the farmers themselves who contribute 6*d*. per cwt. of cocoa sold for them. The value of the Cocoa house as an instruction centre is shown by the increasing number of farmers, who having learnt the process, now cure their own cocoa under supervision, but sell it collectively with departmental assistance. This tendency is the most encouraging result of the project and it is chiefly by an extension of this enterprise on the part of a peculiarly conservative race, that one may anticipate improvement in the quality of Nigerian cocoa in the future. The following table shows the progress of the co-operative fermentation scheme to date :—

Season.	Tons Cured in Cocoa houses.	Tons Cured under Supervision.	Tons total	Average Price per ton F.A.Q. (1)	Average Premium per ton on fair fermented (2)
1922-3. ..	39	41	80	£ 17	£ 4
1923-4 ..	81	205	286	£ 16	£ 4 10s.
1924-5 ..	155	527	682	£ 23	£ 5 10s.

(1) An average price for the whole season at buying stations in the districts covered by the scheme.

(2) The gross premium. No allowance has been made for extra cost of production or for loss of weight due to fermentation.

THE COLLEGE AT WEMBLEY.

QUEEN MARY on the occasion of a visit to The West Indian Pavilion at Wembley on July 3rd, inspected with evident interest the two models of the Imperial College of Tropical Agriculture, which stands in the Trinidad Section.

Commenting on these models, which are perfect representations on a miniature scale of the new College Building and the Instructional Sugar Factory, Her Majesty showed an intimate knowledge of the objects and aims of the College which are daily becoming better appreciated in this country and the Dominions and Colonies.

The models were specially made for the British Empire Exhibition by Mr. John B. Thorp, the architectural modeller who was responsible for the representations of Old London which form such an interesting feature of the Museum now house, through the generosity of the late Lord Leverhulme, at Lancaster House. The scale of the College model is one-quarter of an inch to a foot. Perfect in every respect down to the minutest detail, they prove a source of great attraction to visitors, who, this year, though less numerous, are more critical of the exhibits.

In the neighbourhood of the models, literature descriptive of the College and its aims are available for distribution.

It is proposed, after the close of the Exhibition, to restore the model of the College Building, which was prepared under the superintendence of Major H. C. Corlette, who designed it, to the Colonial Office, where, through the courtesy of the Secretary of State for the Colonies, it stood in the Entrance Hall from the time of the closing of the old Wembley to the opening of this year's Exhibition.

RUBBER RESTRICTION.

PROFESSOR C. Y. SHEPHARD, B.Sc. (Econ.)

THE agitation against the Stevenson Scheme for the restriction of the output of rubber from British Malaya and Ceylon has received a new impetus from the recent high prices which have been realised for raw rubber. Opponents of the scheme, particularly American rubber manufacturers, claim that the scheme has raised prices to an unjustifiable level and will lead by 1928-1930 to a rubber famine. This last supposition depends upon factors which no one can foresee.

The amazing feature of the rubber industry is its dependence upon the motor car industry, which absorbs 75 to 80 per cent. of the world's production of rubber, a factor constituting both the strength and weakness of the plantation industry. Every expansion in the motor car industry, or in the mileage covered on rubber tyres, involves an additional demand for raw rubber, and any decrease in mileage or increase in the life of the tyre brings about a corresponding decrease in demand for rubber. In view of the fact that it takes five or six years before the rubber tree reaches regular "tappable" age it is surprising to note how production adjusted itself to consumption, although at decreasing prices, until 1921 when a sudden break in prices occurred. This fall in price was due to a relatively small increase in consumption, attributable in some measure, no doubt, to the general world-wide slump, resulting in financial stringency and decrease in motor car mileage, but more particularly, I believe, to the widespread use of the high-pressure cord tyre, which, with its greatly increased life, brought about a check to the increasing demand for raw rubber. Production exceeded consumption even at prices, in many cases, below the cost of production with the result that heavy stocks began to accumulate. With the assistance of the Colonial Office the Stevenson Restriction Scheme was brought into force in British Malaya and Ceylon. The scheme itself has so frequently been described that it is unnecessary to give any detailed description here. The objects were, briefly, to dispose of the large accumulated stocks of rubber, and to raise prices to levels above the cost of production, thereby ensuring a reasonable rate of profit to the plantations. The scheme endeavoured to accomplish this by restricting exports to 60 per cent. of "standard production" and by raising or lowering this percentage according to price levels during the preceding quarter. The actual exports are kept down to the amounts prescribed in the scheme by a cumulative tax upon all rubber in excess of the exportable allowance at minimum rates. The results are that stocks, in London alone, have been reduced from 83,000 tons in August, 1921, to 4,484 tons on July 11th, 1925, and prices have risen from 7½*d*. per lb. in July, 1921, to 4*s*. 3*d*. per lb. on July 16th, 1925.

Consumers of raw rubber regard these prices as the extortion of an artificially created monopoly. American manufacturers, who consume approximately 70 per cent. of the world's output of plantation rubber, regard it as a restraint upon international trade, and an unfair levy by British producers upon American industry. They predict a world shortage within a few years, based upon the fact that little planting has recently taken place, and assuming, as no one is justified in doing, that consumption will expand in a similar manner to the last few years. It also assumes that even if restriction were swept away estates would be unable to produce up to the standard production owing to the shortage of labour, and that planters would be unwilling to do so owing to a reduction in what is considered the optimum rate of tapping. In view of the avowedly protectionist attitude of their own country and their own desire to obtain cheap rubber, this must be interpreted as an ingenious propaganda for stimulating the new planting of rubber both within their own colonial possessions and those of other nations, and for securing either an abandonment of the Scheme, or an additional exportable allowance over and above that allowed by existing legislation. On the other hand nothing is more likely to stimulate new planting than the existing high prices. The exportable allowance is immediately governed by price levels which in turn, granted a definite supply, are determined by the manufacturers' demands, and they, by pursuing a hand-to-mouth buying policy, have twice kept prices just below the amount necessary to secure an additional 5 per cent. export allowance. Now that they have been compelled to purchase comparatively heavily prices have in consequence risen rapidly. On the other hand the additional 10 per cent. permitted on May 1st is only now coming on the market; August will doubtless bring another 10 per cent. and October probably another. The cumulative effect of these increases will be felt during the period when purchases are usually relatively small.

The producer, apparently, has every cause to congratulate himself. He can increase his production by 10 per cent. with the prospects of additional allowances to come, and sell at prices allowing him a handsome profit which will compensate, in some measure, for the losses of the slump years. That, however, is a short-sighted view. High prices will stimulate other producing areas—as Restriction did in the Netherlands East Indies—and will call forth supplies of wild rubber and reclaimed rubber which were wholly or largely eliminated during the period of low prices. Moreover it will tend to restrict the growing number of uses for rubber. As has been pointed out, motor tyres consume 75 to 80 per cent. of the world's rubber, and producers, realising this unenviable position, have expended much thought and money in endeavouring to stimulate other uses. Rubber has been styled the product with a thousand and one uses but unfortunately, apart

from motor tyres, the uses do not consume much raw rubber. Demand for minor purposes has been stimulated by low prices but this demand will now be curtailed and much of the ground laboriously gained will be lost. In the long run it is neither desirable from the point of view of the producer nor the manufacturer that excessively high or low prices should rule, since both are detrimental to both interests. The Scheme allows for a steady expansion governed by demand and by the end of the year production should have increased sufficiently to meet all existing demands and allow some surplus to replenish stocks which at present are dangerously low. To scrap the Scheme would be to recognise absolute failure where it does not exist and to make it impossible to re-introduce a Scheme which has been the salvation of the rubber industry. The Scheme should be continued even after standard production has been reached so as to act as an insurance against a repetition of the disasters of 1921. The statement that the British Empire's share of plantation rubber production has declined from 100 per cent. before restriction, to little more than 50 per cent. under restriction, may be viewed with equanimity for it is not to the advantage of any territory to produce commodities at prices below the cost of production nor, as in Malaya, to rely wholly upon the fortunes of a single crop.

Foreign owned plantations in British Malaya and Ceylon are brought under the Restriction Scheme. The majority of British-owned plantation in India and the Dutch East Indies have voluntarily, either with or without reservations, subjected themselves to the Scheme. The following is an estimate, expressed in United States dollars, of the capital invested in rubber plantations in the East.

	Amount.	*Per Cent.*
Great Britain	$505,000,000	57·6
Netherlands	130,000,000	14·8
Japan	42,000,000	4·8
United States	32,000,000	3·7
France and Belgium ..	30,000,000	3·4
Shanghai	14,000,000	1·6
Denmark	11,000,000	1·3
All other, including native-owned areas ..	112,000,000	12·8
Total	$876,000,000	100·0

Net exports of Plantation Rubber from the East.

Years.	British Possessions.					Netherlands India. Tons.	French Cochin-China. Tons.	Grand Total Middle East. Tons.	British Share of Grand Total. Per Cent.
	Ceylon. Tons.	British Malaya. Tons.	India and Burma. Tons.	British Borneo. Tons.	Total British. Tons.				
1905	70	104	..	..	174	..	..	174	100
1906	145	432	..	..	577	..	..	577	100
1907	250	905	..	2	1,157	..	..	1,157	100
1908	390	1,402	..	4	1,796	..	..	1,796	100
1909	681	2,698	..	7	3,386	..	..	3,386	100
1910	1,522	5,713	..	34	7,269	..	..	7,269	100
1911	3,061	10,895	332	95	14,383	..	..	14,383	100
1912	6,628	20,540	643	277	28,088	2,025	..	30,113	93
1913	11,325	33,213	1,040	608	46,186	5,535	..	51,721	89
1914	15,336	46,430	1,343	883	63,992	8,970	191	73,153	87
1915	21,787	70,516	2,161	1,631	96,095	17,811	371	114,277	84
1916	24,384	97,837	2,781	3,058	128,010	30,443	540	158,993	81
1917	32,290	134,788	3,992	4,312	175,382	44,889	916	221,187	79
1918	20,665	107,691	4,377	4,193	136,926	43,345	529	180,800	76
1919	45,010	199,545	6,554	6,375	257,484	88,189	2,901	348,574	74
1920	39,532	174,322	6,376	5,851	226,081	75,522	3,068	304,671	74
1921	39,342	151,001	5,305	5,311	200,959	72,227	3,560	276,746	73
1922	46,694	212,380	4,854	7,661	271,589	102,171	4,472	378,232	72
1923	37,111	183,812	6,417	10,094	237,434	137,158	5,146	379,738	63
1924 (1)	37,338	152,320	7,161	8,208	205,027	175,298	6,378	386,703	53

(1) Estimated; subject to later revision.

Messrs. Thomas Boyd & Co., Ltd., of Trinidad, agents for Cadbury Brothers, Ltd., have favoured us with a copy of the Bournville 1925 publication on Transport. This interesting brochure describes the various means of transport utilised in bringing the great variety of raw materials necessary for the Bournville industry to the factory. The text is written in non-technical language and is abundantly illustrated by a large number of excellent photographs, and depicting almost every type of transport from the primitive head porterage to the latest type of motor lorry.

THE ISOELECTRIC THEORY.

Its Application to Certain Problems of Crop Products Manufacture, and Soil Fertility.

By PROFESSOR F. HARDY, M.A.

[*This Article forms the Second Part of a series of articles that attempt to apply a modern theory of colloidal behaviour to some tropical agricultural problems. This theory appears to underlie many apparently diverse processes connected with crop production, and its appreciation aids in better understanding. Part I of the series appeared in the last (August) issue of this Journal. In it the Isoelectric Theory was stated and explained, and consideration was given to the general question of precipitation of hydrophilic colloids when treated with certain electrolytes.*]

PART II.

II.—APPLICATION OF THE ISOELECTRIC THEORY.

(*a*) Manufacture of Certain Crop Products.

1.—*The Coagulation of Rubber Latex.*

Although many theories have been propounded to explain the coagulation of rubber latex by various agencies, it is only recently that an explanation which appears to satisfy most of the conditions determined by observation and experiment, has been evolved. This explanation is definitely based on the isoelectric theory of colloidal behaviour as outlined in an earlier section. It was apparently first submitted by W. N. C. Belgrave, of the Malayan Agricultural Department (1). The following account is taken mainly from Belgrave's paper, with the addition of certain comments that appear necessary.

The fundamental assumption accepted by Belgrave is that rubber latex consists of a serum containing numerous minute particles of semi-solid caoutchouc, each of which is surrounded by a thin envelope ("adsorption film") of some protein, which confers its properties on the particle, and determines its behaviour under changing circumstances. This view of the composite nature of the caoutchouc particles of rubber latex is one that has long been widely accepted (2).

The effect of successive small additions of dilute hydrochloric acid on the degree of acidity (pH value), and on the conditions of stability of rubber latex, were traced by Belgrave, and it was shown that rapid coagulation commenced at a pH value of approximately 4·9. As this degree of acidity was approached, the viscosity of the latex was found to increase, and, furthermore, it was noted that a considerable rise in surface tension occurred when coagulation set in. These facts amply demonstrate the importance of degree of acidity in the coagulation process, and furnish sufficient initial reason for applying the isoelectric theory in explanation, because the figure pH 4·9 is of the same order as the established values for the isoelectric points of proteins.

Further measurements of the effect of adding more acid, showed that rapid coagulation of rubber latex occurs within a certain rather wide pH *region* extending from pH 4·9 to pH 2·5, and that, beyond this region, there exists another region (the acid "gap" of Whitby), within which the latex again exhibits stability, extending from pH 2·5 to about pH 1·5. Finally, at pH values less than this, when the latex is relatively very highly acid, coagulation occurs once more. These results furnish clear reasons for the well-defined differences that exist between the various acids that have been proposed as coagulants. Thus acetic acid is "fool proof" because it is not sufficiently strong an acid to confer a reaction much more acidic than about pH 3·0, even if used in amount one hundred times greater than that usually employed in practice. Acetic acid thus never reaches the stable "acid gap." Formic acid is comparable with acetic acid in these respects, and is known to be even a more satisfactory coagulant. Acids *weaker* than acetic acid (for example, boric and hydrocyanic acids) fail to change the reaction of latex to pH 4·9, and therefore cannot effect coagulation, as may easily be demonstrated. Acids somewhat *stronger* than acetic acid (for example, oxalic acid) may produce a reaction of pH value lying within the acid gap, and may therefore not effect coagulation at all. Finally, strong mineral acids, such as hydrochloric acid, although they might effect coagulation at pH values higher or lower than that of the acid gap, if used in suitable concentration, are known to impair the vulcanizing properties of the resulting raw rubber, and are hence liable to lead to serious mistakes if used by unskilled operatives.

The *natural* coagulation of rubber latex that may occur in latex that has not been disinfected, is explained by Belgrave as primarily due to the formation of acidic substances through the activities of certain micro-organisms. This definitely disposes of vague vitalistic theories of coagulation. The theory also explains why weak alkalies, such as ammonia, and certain buffer salts are effective latex preservatives, in that they reduce or suppress all tendencies that lead toward increase in acidity.

Perhaps the best test of the applicability of the isoelectric theory of colloidal behaviour to the case of rubber latex lies in its ability to explain results that are obtained when certain salts are added to latex at different pH values. This particular phase of the general question was not critically examined by Belgrave from the point of view presented in previous sections, but certain of his experimental results appear to have direct bearing.

1. Belgrave's data show that calcium-ion is an efficient precipitant for latex particles at reactions more alkaline than the reaction which

corresponds to the alkaline end of the isoelectric region, namely pH 4·9. Thus neutral (pH 7·0) calcium chloride solution added to *fresh* latex rapidly produces a coagulum. Fresh latex was found by Belgrave to have a pH value of about 6·0 (range pH 5·8-6·3) which is on the alkaline side of the assumed isoelectric point of the protective protein (pH 4·9). Hence this result (which had often previously been noted), is in accord with the isoelectric theory. The reason why neither calcium salts in alkaline solution, nor calcium hydroxide, are usually employed as latex coagulants is presumably that the calcium compounds are difficult subsequently to wash out from the raw rubber, whose rate of vulcanization and physical properties are adversely affected by their presence.

It is also known that latex containing relatively excessive amounts of calcium-ion as a *natural* component, are more prone to spontaneous coagulation than is latex of normal composition. Belgrave points out that the latices of very young trees, of poor yielders, and possibly also the latex of the bark of Hevea trees suffering from brown bast disease, possess this characteristic. Such being the case, there may be some direct connection between soil conditions and the properties of latex, for the calcium content of cell saps doubtless varies with the composition of the soil.

2. Reagents that precipitate calcium from alkaline solution, such as soluble oxalates, fluorides and carbonates, are known to be effective anticoagulants of alkaline latex. This would follow naturally from foregoing considerations.

3. Belgrave's data show that the relative flocculating powers of the kations (metallic ions) of various salts, follow approximately their order of affinity, provided the reaction of the latex is on the alkaline side of the isoelectric point. This also is in full accord with the theory.

4. Belgrave's data for relative flocculating powers of sulphate-ion and chloride-ion added to *acidified* latex (pH 1·5-2·2), prove that sulphate-ion is much the better flocculant, which again is in accord with the affinity law, and with a specific property possessed by proteins. Belgrave's results further prove that, on the acid side of the isoelectric point, anions and not kations are the effective precipitating agents.

In all these instances, then, theory agrees with fact, and it appears entirely reasonable to accept the view that coagulation phenomena in rubber latex are manifestations of the reactivity of lightly-hydrated proteinous matter that effectively protects globules of caoutchouc dispersed in an aqueous serum.

REFERENCES.

(1) Belgrave, *Malayan Agric. Journ.*, XI, 12, Dec., 1923, p. 348.
(2) Freundlich and Hauser, *Indiarubber Journ.*, LXIX. 17 Apr. 25, 1925, and *ibid.*, May 2, 1925. Also Van Rossem *ibid*, LXVIII, 22, Nov. 29, and Dec. 6, 1924.

AGRICULTURAL NOTES.

COMPILED BY THE COLLEGE DEPARTMENT OF AGRICULTURE.

Adlay: a promising food crop in the Philippines.

THE wild form of this plant is commonly known in the West Indies as Job's Tears (*Coix lacryma-jobi*, L.), a coarse grass, the seeds of which are used for making ornaments, necklaces, &c. On the other hand, the seeds of the form discussed in this note have soft hulls, easily removed from the kernel, which is grown as a grain in the Asiatic tropics. Information concerning adlay has appeared from time to time in Philippine agricultural literature; this has now been brought up to date and published as Circular No. 128 (Revised) by P. J. Wester, Agricultural Adviser to the Bureau of Agriculture, Manila.

As grown in the Philippines, Wester states that adlay is represented by several very distinct species, but so far the small-grained, thin-hulled, creamy-white to light-tan-coloured sorts appear to be the most satisfactory. The plant succeeds best when grown for grain on friable, loose to loamy, fairly rich soil, and should not be planted on heavy clay land, although in low moist soils it produces good crops of green forage. It should be planted at the beginning of the rainy season to get full benefit of the rains for proper development, harvesting being carried out in the dry season. The seeds are planted three to five per hill, hills sixteen to twenty-four inches apart, in rows twenty-eight to thirty-six inches apart. The yields in grain compare very favourably with or exceed those of rice, maize or wheat.

Analyses indicate that adlay exceeds in food value four of the principal grains: wheat, rice, corn and oats. It appears to be a far better balanced food than either rice or corn, the two chief grains in the Philippines at the present time, and from trials made, there is every indication that adlay flour can be used to substitute or supplement wheat flour in both bread and pastry. After giving a number of recipes in which adlay flour was used with every satisfaction, Wester concludes from the results so far obtained that adlay merits serious attention as a grain crop in the Philippines.

Bananas: methods of grading and packing in Queensland.

THE banana industry of Queensland appears to be making considerable progress, but as an article in the Agricultural Journal recently points out, it is not profitable to produce or market any bananas unless they are of good eating quality. In connection with marketing, the article in question gives some interesting ideas.

First of all, care in cutting and handling in the field to ensure freedom from bruises is emphasized. For Commonwealth markets, the bunches are next cut up into hands; then they are carefully

sweated at least 40 hours prior to packing. Next the full hands are cut or broken up into smaller hands—'twos' 'threes,' 'fours,' 'sixes' or even 'singles,' depending on the demand. It is claimed that the ideal pack is in 'full' hands and these are often desired by some agents, but difficulty is experienced in packing a firm case in this way owing to the different shapes of the bananas and consequently breaking has to be resorted to. In this operation, the fingers should be grasped firmly at the stalk end and not at the flower end.

Perfect sizing is essential for perfect packing, and three sizes or grades for Cavendish—the variety grown commercially—are recognized: "Special"—sound fruit, free from blemish and properly packed, having a minimum length of eight inches and a minimum circumference of five inches; "Choice"—sound fruit, properly packed, having a minimum length of over seven inches to eight inches and a minimum circumference of four inches; "Standard"—sound fruit, properly packed, having a minimum length of five and a half to seven inches and a minimum circumference of four inches. All measurements for length are taken on the outside of the curve from the junction of the fruit at the stem-end to the top of the fruit. In grading, all undesirable, bruised or injured specimens are discarded. The pack should be tight and uniform all through: to accomplish this the packing must be done in layers. A good foundation is essential and much depends on the first layer, which should be firmly placed in the case; this finished, the second layer is placed concave downwards, and so on until the case is full, care being taken not to lay the fruit directly on top of each other but in the crevices or spaces. This precaution prevents shifting and movement of the fruit in the cases.

The system of handling given above doubtless entails much labour and expense; on the other hand, the Cavendish banana carries with difficulty unless crated. The method here devised also saves on freight, and finally—a very important consideration—prevents the small bunch from being penalized as is usually the case when bananas are shipped in bulk. While of interest in connection with the projects now in hand looking to the establishment of a profitable industry in the Lesser Antilles, it is questionable how far an industry of considerable size could be built up along these lines, some distance away from markets, if the fruit is not to be considered as a luxury.

The Planter and Sugar Manufacturer, commenting in appreciative terms on the opening of the Experimental and Instructional Sugar Factory of the Imperial College of Tropical Agriculture states that the Audubon Sugar School is now equipping a new model sugar factory on the site of the Greater Agricultural College at Baton Rouge and calls the attention of the American Sugar Machinery Manufacturers to the generosity of British Sugar Machinery Manufacturers in equipping our model factory.

WEST AFRICAN PALM OIL.

A comprehensive review of the West African Palm Oil Industry by Sir Frederick Lugard was published in the June issue of this Journal.* In September, 1923, the Secretary of State for the Colonies appointed a committee to consider the best means of securing improved and increased production in this industry. This Committee has recently published its report.† The most disturbing feature from the West African point of view, is the rapid progress made on the oil plantations of Sumatra, Malaya, &c. On the East Coast of Sumatra the area planted is said to have reached 30,000 acres on January 1st, 1923, and the Sumatra planters estimate that within 10 years the area will be increased to 100,000 acres, and that in 15 years the East Coast alone will export more palm oil than West Africa during her pre-war record year. The danger is not one of mere area, but rather of methods and costs of production. The palm oil industry of the Dutch East Indies has been built up upon scientific plantation methods and has the benefit of the work by the Algemeene Vereeinging van Rubber-Planters ter Oostkust van Sumatra (the A.V. R.O.S.) which keeps the planters in close touch with every new stage of development concerning the planting and cultivation of the palm, and the methods of producing palm oils and kernels. The result is that the planters of the Dutch East Indies can place oil upon the European markets at prices substantially lower than West Africa in spite of the great difference in proximity to the markets.

In the old established West African Industry cultivation may be said to be non-existent. The oil palm exists in a wild state over large areas so that initial costs of planting and cultivation are avoided, but, on the other hand, access to these palms is often difficult and expert climbers are necessary for cutting the fruit bunches. In the well ordered plantations of the Dutch East Indies access is easy and the palms, relieved of the necessity of struggling for light, do not attain so great a height. In West Africa much of the crop remains untouched and of that collected much is wasted by crude methods of extraction. In collecting numerous small quantities of oil, both fresh and partially rancid oil are mixed, so that the eventual product contains a large percentage of free fatty acids which detract from its commercial value.

Those interested in the British West African Industry are deeply impressed by the fate of the West African forest rubber industry and some even predict that the palm oil industry will share the same fate. This prophecy is open to question but since it is beside the point we need not examine the question further. Even if the West African industry does not die out one cannot fail to be impressed by the enormous waste in uncollected fruits, the crude methods of extraction, which are wasteful of both labour and oil, the poor quality

* *Tropical Agriculture* Vol. II No. 6, pp. 119–121.

† *West African Palm Oil and Palm Kernels.* Col. No. 10, 1925, Price 9d.

of the product and the high costs of production. It is fairly generally agreed that there is an immediate necessity for the erection of central factories equipped with modern machinery, and it is also recognised that such factories can only be erected by means of European capital. As regards the inducements to be offered to attract this capital there is the widest divergence of opinion. The committee considers that a mill dealing with 6,000 to 10,000 tons of fruit per annum should prove an economic proposition in West Africa and that for this purpose the grantee should be permitted to acquire an exclusive right to erect power-driven machinery within a radius of seven miles. Within this area it is suggested that sufficient land to supply one-third of the mill's requirements should be granted to the mill-owner for the purpose of cultivating palms on plantation lines in order that he need not be entirely dependent upon the natives for bringing fruit to his mill. The remaining two-thirds would have to be purchased from the natives of the surrounding district. The area thus granted as an agricultural concession would have to be acquired from the native owners on a long lease, say 99 years, adequate compensation by way of rent or otherwise being given for the palms already on it, and for the renunciation by the natives living in the district of their rights to hunting and shifting cultivation over it and of residence on it. It is recognised that it would be an additional inducement if it were made legal for the mill-owner to enter into contracts with the natives by which they agreed to supply a quantity of fruit to the mill at a specified price. In the event of the natives failing to fulfil their contracts the mill-owner should be free, but not obliged, to hire labourers and collect fruit up to the total specified in the contract, subject to a payment to the native owners of the oil-palms by way of royalty. As a last inducement the Committee recommends that the mill-owner should be given the exclusive right to use mechanical transport for the purpose of collecting oil-palm fruit in the area within seven miles of his mill, provided that native owners of palms should be permitted to use their own motor transport for collecting and marketing their fruit.

The proposals will be regarded by many as depriving the native of too many rights, but on the other hand it must be recognised that these inducements form an irreducible minimum if sufficient capital is to be attracted within a reasonable period. Mr. Smart, a member of the Committee, adds a rider to the effect that, in his opinion, it would pay the African very much better to give such greater inducements as will more quickly—before Sumatra, &c., establish a lead—attract ample capital to develop the industry, because it is probable that in ten years hence it will be too late to offer inducements which might be ample if offered now. Great Britain has declared that she holds these lands as a trustee for the natives but on the other hand there is the parallel obligation to develop these resources for the benefit of mankind in general, and there appears no valid reason why both these obligations should not be fulfilled. Difficulties regarding prices to be paid for the fruit might be solved by means of a sliding scale based upon the prices realised for the oil over definite periods, and divisible into three parts, of which the Government would take one share, the mill-owner another for manufacturing, and the collector the other for his fruits. The Government's share should always be small but should increase with high prices and decrease, or even disappear, with low prices. Sums acquired in this manner should constitute a development fund and be utilised solely for the purpose of improving the contributing areas by means of increased transport and other facilities. Land and other concessions should be granted to the mill-owner not freehold, but on a long lease subject to periodic revision in order that the Government and the native owners may share in the unearned incremental value of the land due to external improvements in the shape of transport and other facilities. Finally it should be emphasized that the attraction of capital will provide but a partial solution, and that if the industry is to be established upon a sound economic basis, by which it would be enabled to compete on terms of equality with the Dutch East Indies, action must be taken immediately, for every year that is lost will see the foreign industry more firmly established and make a re-organisation of the British more difficult.

C. Y. SHEPHARD.

TRANSACTIONS OF THE INSTITUTION OF THE RUBBER INDUSTRY. Price 4*s*. 6*d*. Published Bi-monthly by the Institution of the Rubber Industry, Faraday House, Charing Cross Road, London, W.C. 2.

The Institution of the Rubber Industry has hitherto published the papers read at its meetings in the form of Year Books, three of which have appeared. These Books, each containing the whole of the Sessions papers in a compact volume, have been of great value but members living at a great distance from the centres where the meetings were held were obliged to wait a whole year for the volume to appear. Hence it has been decided to publish the papers in a bi-monthly official organ, the first of which is now before us. These Transactions will serve to keep the members in closer touch with the Institution's activities and while we regret the disappearance of the Year Books it must be admitted that the move is in the right direction. The first four issues will be devoted to the papers which would normally have been published in a "Fourth Year Book" and considerations of space will prevent more than the substance of each address being included. With the removal of arrears of publications, a more generous allotment of space will be possible for the insertion of complete papers and the relative discussions.

CHEMICAL NOTES.

Compiled by the Department of Chemistry and Soil Science.

The Non-Volatile Acids of Cacao Seed Pulp and Cacao Sweatings.

In an article appearing in the *Journal of the Society of Chemical Industry*, Vol. 44, No. 25, June, 1925, F. Hardy describes the results of his investigation of the non-volatile acids of cacao seed pulp and cacao sweatings. The results indicate, that in both, citric acid is the only non-volatile acid present in any appreciable quantity.

Canna Starch.

The starch in which the corms of the edible Canna (*Canna edulis*) abounds, occurs in grains of relatively very large size. It is therefore eminently suitable as a food stuff for infants and invalids. Field trials in Hawaii* have demonstrated that 18 to 20 tons of Canna corms can be produced in nine months, per acre of land. The feeding value of both corms and tops compares favourably with that of other starch and forage crops. Moreover, the crop can be harvested any time during the year, because the underground parts do not appreciably deteriorate if allowed to remain in the ground, even for periods as long as two years.

Payment for Sugar-cane according to Sucrose Content.

The Co-operative Sugar Planters, Ltd., of Umfolzi, South Africa, have adopted a new system of payment for sugar-cane, based on the actual sucrose content of the cane delivered to the factory. The company's technologist controls the reaping operations so that the sugar-canes reach the mill when their sucrose content is the greatest. This necessitates repeated samplings and analyses of all the canes growing in the settlement, and the keeping of accurate records of rise and fall of sucrose, purity, &c., for the canes of every field of each farm. The system of individual analysis is briefly described in the Report of the first annual meeting of the company. It is believed that the system of payment by individual analysis will soon become automatic. —*Botanical Abstracts*, Jan. 1925, p. 4.

Synthetic Myethl alcohol.

Methyl alcohol (wood spirit) is usually obtained commercially from the products of dry distillation of wood, a method first used by Boyle as long ago as 1661. Ever since 1877, numerous attempts have been made to develop a satisfactory process for preparing methyl alcohol by synthesis from hydrogen and carbon monoxide. It was soon found that these two substances could readily be made to combine under the influence of a suitable catalyst, but, at ordinary atmospheric pressure, the product was never methyl alcohol, but either formaldehyde or ethylene, depending on temperature.

In 1921, Patart,* in France, re-investigated he problem, and attempted to apply the well-known principle of Le Chatelier, which had previously been used with such great effect by Haber in his invention of the synthetic process for making ammonia from its elements. In other words, Patart investigated the reaction between hydrogen and carbon monoxide at high pressures. By the use of a suitable catalyst, and a temperature range of 300° to 600°C., Patart succeeded in inducing hydrogen and carbon monoxide to combine to form methyl alcohol, at pressures approaching 200 atmospheres. The process was immediately tested on an industrial scale, with completely satisfactory results. An effective catalyst used by Patart was a mixture of copper (90 per cent.) and zinc oxide ; this is little affected by impurities in the gases used for the synthesis, so that water-gas may be employed as raw material.

In 1923, the Badische Company in Germany, further developed the industrial synthesis of methyl alcohol, and soon succeeded in making the product at the rate of 10 to 20 tons per day. Synthetic methyl alcohol made in Germany is now offered for sale (March, 1925) in the United States of America at a price somewhat less than that of the wood product (which sells at 65 cents per gallon in tanks; 95 per cent. purity). The cost of production, on the gold basis, is only 18 to 26 cents per gallon, so that the selling price of synthetic methyl alcohol could be greatly reduced, and still leave a margin of profit.

There is no doubt that synthetic methyl alcohol will soon displace wood spirit, thus furnishing another instance of the triumph of the chemical engineer, whose ingenuity seems to be rapidly undermining many well-established plant products industries.

The interaction between hydrogen and carbon monoxide under other different conditions yields additional products, such as acetone, and liquid polymers of ethylene. These latter products are combustible substances similar to the hydrocarbons that comprise petroleum, and it is suggested that Patart's discovery may prove to be the key to the liquid fuel problem. So long as we have coal and water, it would seem that, through catalysis, solid fuel may economically be transformed into the much desired liquid fuel. The field is new, and the opportunities correspondingly great.

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* *Hawaiian Agric. Expt. Stat. Bul.*, 1924, No. 54.

* See Lormand, *Indus. Engin. Chem.*, April, 1925, p. 430.

ENTOMOLOGICAL CONFERENCE.*

Meeting of Imperial Delegates.

THE second Imperial Entomological Conference, which was summoned by the Secretary of State for the Colonies at the instance of the Imperial Bureau of Entomology, was held in London on June 9-18, and was attended by twenty-one delegates, representing the governments of most of the British Dominions and Colonies. The delegates were received by Earl Buxton, chairman of the Committee of Management of the Bureau, at Burlington House, where the meetings were held. They were also invited to a reception at the British Museum (Natural History) and to meetings of the Zoological and Linnean Societies, and were given the opportunity of visiting Oxford and Cambridge, and the Rothamsted Experiment Station and the Ministry of Agriculture's Pathological Laboratory at Harpenden.

The public meetings of the Conference occupied four days, one of which was largely devoted to the general aspects of applied entomology. Dr. G. A. K. Marshall, Director of the Bureau, read a paper on "The Aims and Organisation of Economic Entomology." After briefly reviewing the steadily increasing importance of tropical agriculture as a source of the world's food supply and raw materials, he said that the economic effect of insect pests is not fully realised. The suggestion sometimes made that crops that suffer severely from pests in a given country should be abandoned in favour of others is not feasible in the case of essential crops, and as the world's population increases, it will become more and more necessary to protect them from insect pests.

The present organisation of economic entomology is unsatisfactory. Economic entomology should be preventive, but a government entomologist, responsible for a huge area of country, cannot hope to do more than wait to be called in by planters for advice, which only happens when an outbreak of a pest is well under way, and its control has become difficult, if not impossible. What is required is that the planters should themselves employ their own entomologists, who would be continually working on the problems of their special crops, and would take steps to prevent outbreaks of pests from arising. This would effect an enormous saving, and should be regarded as a form of insurance. The Hawaiian Sugar Planters' Association affords an excellent example of how a scheme of this sort should be put into practice. The government entomologists would then be free to undertake research.

Dr. T. W. Munro gave an account of the organisation of forest entomology in England, and in the discussion that followed, the various systems of economic entomology at home and in a number of the Dominions and Colonies were described. A point strongly emphasized here, and also at the other meetings, was the diversity of problems presented, not only by the obvious differences of climate, crops and pests, but also by the great differences in the populations concerned. Thus in Egypt, where agriculture is chiefly in the hands of the illiterate classes, measures against insect pests are not only organised, but also actually carried out, with excellent results, compulsorily by the government, the growers paying the bulk of the cost; whereas, at the other end of the scale, in South Africa all that is necessary is for one of the more progressive men in a district to be shown what to do, the others being only too glad to imitate his work.

In discussing the qualifications of an economic entomologist, Mr. H. H. King pointed out that he must not only have had the necessary scientific training, but must also have personality and a knowledge of men, so as to be able to convince those with whom he has to deal that they would benefit by carrying out the measures he suggested.

Several of the meetings were devoted to pests of particular crops and other aspects of economic entomology in the various colonies, and a great deal of valuable information was interchanged; but they were, of course, of rather specialised interest. Perhaps the most important discussion of the meetings, however, particularly in view of the reports of the East Africa Commission and of the League of Nations Conference on the subject (*Nature*, June 27, p. 985), was "Co-ordination of Effort in Tsetse-fly Investigations." The chair at this meeting was taken by Mr. W. Ormsby-Gore, Under-Secretary of State for the Colonies. In opening the discussion, Prof. Warrington Yorke said that the problem is not purely entomological, but comprises four factors, namely, the trypanosomes concerned, the population and domestic stock, the transmitting agent or tsetse-fly, and the reservoir of the virus, or big game. An advance can only be made by taking into consideration at the same time and in the same locality all these factors. In short, he advocated centralisation of effort. Much of the scattered work at present being carried out is failing to produce satisfactory results owing to its being misdirected, to lack of continuity and to lack of funds. He thought, however, that the International Commission suggested by the Sleeping Sickness Conference that met in May under the auspices of the League of Nations was premature, and that knowledge is not yet sufficiently advanced for regulations to be formulated governing the international frontiers of tropical Africa. More is to be hoped for from an inter-colonial conference, by means of which the work of entomological, medical and veterinary research could be combined under one central organisation, supported by pooled contributions of all the colonies interested.

Mr. C. F. M. Swynnerton agreed that co-ordination between the different branches of science was very necessary, but considered that a central organisation would meet with almost insuperable difficulties. He pointed out that there are twenty species of tsetse-fly, each having its own requirements in the matter of habitat and possibly fauna, and also occurring in a variety of combinations.

* *Nature* No. 2905, Vol. 116.

There are thus probably fifty different tsetse-problems in different parts of Africa. Each colony should have its own department for the subject; touch should be maintained between the colonies by mutual visits and, if possible, by a travelling director who should go from colony to colony. He described the work in Tanganyika Territory, an account of which has already been given in *Nature* of March 7, p. 338, and showed how co-operation has been obtained not only among the various scientific departments, but also with the natives themselves. International and inter-colonial co-operation must be provided for, as the problems are often the same on different sides of political boundaries. He does not consider measures against game justifiable in the present state of knowledge; and even if they proved to be so, they would be very difficult in practice. He gave instances of cases in which they have actually defeated their own object.

Dr. A. Balfour agreed with the need for inter-colonial co-operation, but considered that, as the problems in the east and west of Africa are so different, and intercommunication so difficult, it might be better to have two organisations instead of the single one suggested by Prof. Yorke.

Major E. E. Austen objected to Prof. Yorke's unqualified statement that game is the reservoir of sleeping sickness. He supported the idea of an International Commission, for, in the special problems to be dealt with, political boundaries are often not natural ones. He emphasized the multiplicity of the problems presented by the various species of tsetse-fly and the consequent need for attacking them by every feasible method. Dr. A. G. Bagshawe pointed out that it is only within the last two years that we have been shown by Mr. Swynnerton that valuable land can actually be recovered from the fly. All efforts should be concentrated on making this work a success on a larger scale. Dr. G. A. K. Marshall observed that trypanosomiasis has to be dealt with on two main lines: the attack upon the disease, and the attack on the flies. A single comprehensive investigation in one place may be excellent on the medical side, but on the entomological side there are numerous problems that can only be solved by investigations in many different localities. While on the medical side further extensive research is the primary need, this is not the case on the entomological side, at least in those countries where the advance of the flies constitutes a dangerous menace. Here the primary need is for an immediate direct attack upon the flies by methods similar to those so successfully employed by Mr. Swynnerton, accompanied by appropriate research. One great difficulty in the past has been procuring the necessary funds; and the reclamation of valuable land by a direct attack on the fly is more likely to appeal to the governments and commercial interests concerned than any programme of purely scientific research.

The chairman supported the idea of an International Commission as proposed by the League of Nations Conference, not only from the scientific point of view, but also from that of educating the general public and the administrators. Money is essential, and public interest must be directed to the economics of the problem. From this point of view the veterinary side is of enormous importance. A scheme that suggests the killing of big game when the smaller animals would remain is contrary to common sense, but a practical policy, such as that of Mr. Swynnerton, should obtain public support.

Before the Conference ended resolutions were passed recommending, among other things, that a similar conference should be held in London every five years; that meetings of entomologists and other scientific officers should be held in the Dominions and Colonies for the discussion of mutual problems; and that the work of the Imperial Bureau of Entomology should continue on the present lines and be somewhat extended in connexion with the export to Oversea Governments of beneficial parasites.

The Conference concluded with a dinner given by the Government in honour of the delegates, at which Mr. L. C. M. S. Amery, Secretary of State for the Colonies, presided.

IMPERIAL RESEARCH.

IN our last issue we noted that Lord Balfour had stated in the House of Lords that the Government intended to set up an Imperial Civil Research Committee for the purpose of dealing with the many insistent civil problems of the colonies for the solution of which there existed no adequate departmental machinery. A preliminary meeting attended by, among others, Lord Balfour, Mr. Amery, Mr. Ormbsy-Gore and Sir Warren Fisher, has already been held for the purpose of surveying the field and formulating a general programme.

The report on East Africa emphasized the great importance of scientific research and the need for greater efforts in this direction. It is understood that the committee will take steps to enlarge and improve the provision for research in many directions. Increased activity is necessary, for example, in medical research, the exploitation of mineral wealth, problems concerning crop production, animal husbandry, the utilisation and development of forest areas, the improvement of existing industries, and the development of new ones, a survey of water supply, and the eradication or control of pests and diseases.

The Committee will proceed to appoint special sub-committees for the purpose of investigating particular problems. Some considerable time must, of necessity, elapse before a definite policy can be formulated but the task is being approached in a systematic and thorough manner and it is hoped that the many gaps which now exist in connection with Colonial Research will in due course be filled up. The Government has tackled the question with refreshing despatch which augurs well for the future. It is evident that the £2,000 a year voted by the Imperial Parliament is regarded as pitiably inadequate. The problems to be dealt with are immense but so are the potentialities of the areas which the Committee seeks to develop.

BOOK REVIEW.

CROP PRODUCTION IN INDIA—A Critical Survey of its Problems. A. Howard, C.I.E., M.A., Oxford University Press, 1924. pp. 200. Price 10*s*. 6*d*.

This book deals with the application of broad principles to local conditions and the view taken of it will depend to a large extent on the aspect from which it is approached. To the person practically interested in the local problems its appeal should be large; the wide and somewhat unusual direction from which the subject is approached can only broaden the views of such an one. To a person unconversant with the local problems there must be a certain danger from mistaking the local aspect for the general issue. Nevertheless, with the exercise of due caution in this respect, the book should appeal to a far wider field than India.

India is a country of alternations; of dry periods and of wet. From the crop aspect, as much harm is done during the latter periods as during the former. Control of run off during the latter periods has an importance as great as conservation during the former. Such control must be effected so as not to interfere with soil aeration which is, if not the most, at least a very important factor in crop production. Here, perhaps, is the most valuable feature of the book, for attention is directed to that much neglected part of the plant, the root. In crop production the root plays in practice a rôle of added importance for it is in intimate association with the soil, the conditions of which are largely controllable by man. By such a study of the root the predisposing causes of disease will be brought to light. And if soil aeration, like King Charles' Head, crops up repeatedly, there is little reason to grumble; over-emphasis is the only method of gaining for a neglected subject a fair degree of consideration.

The discussions of individual crops bear the same tendency; a study of varietal adaptation to soil conditions is as important as the study of the particular character on which depends the economic value.

Less satisfactory is the selection of the economic factors on which crop production depends. The chapters on organisation of the seed supply and on the fodder problem touch on only two of these factors. Crop production depends primarily on the plant which must be capable of giving a high yield and high quality, and secondarily on making the conditions of growth conform to the optimum for such development. The economics of the latter problem are not limited to the production of more fodder in order to provide better fed working cattle. As in other countries, the provision of capital and the adaptation of the land tenure system so as to give the most economic holding are fundamental considerations if full benefit is to be derived from the work which the author so ably reviews.

H. M. LEAKE.

COLLEGE NEWS.

The Session 1925-26 will commence on Thursday, October 1st, 1925.

Professor O. F. Boyd left for New York on July 7th, by the S.S. "Vauban" on vacational leave.

Mr. Seagar, recently appointed Lecturer in Tropical Sanitation and Hygiene, was bracketted second, with distinction, in the recent examination of the London School of Hygiene and Tropical Medicine.

Mr. P. E. Turner delivered an address to the Trinidad and Tobago Agricultural Society on "Vitamines." Mr. E. E. Cheesman delivered a lecture to the same society on "Some physiological aspects of pruning."

It is with deep regret that we have to announce the death of Mr. C. T. Berthon, who, in an honorary capacity, designed the College Sugar Factory. The cablegram, which conveyed the lamentable news, lacks details.

We have great pleasure in announcing that at a general meeting of the Liverpool Cotton Association, held on July 6th, £1,000 was voted from the funds of the Association to the Imperial College of Tropical Agriculture. At the same meeting the Association adopted a new form of futures contract, entitled, "The Empire and miscellaneous cotton delivery contract" which we hope to describe in a later issue.

The Hon. W. G. A. Ormsby-Gore, M.P., Under-Secretary of State for the Colonies, addressing a meeting of the Royal Society of Arts on the subject of "Some African Problems" emphasized "the fact that native production cannot possibly succeed in the long run without the guidance and help of a considerably augmented staff of European scientifically-trained agricultural officers. Further, not only do we require the agricultural staff in order to ensure the quality and better cultivation of crops, but we also need a great deal more research in the science of tropical agriculture. In the past we have left these two questions very largely to chance, and to the individual effort of the different Colonial administrations and a handful of officers. The time has come, in my opinion, when we must regard the British Tropical Dependent Empire as very largely one for this purpose. The first big step in the right direction is the establishment on a really effective scale of the Imperial College of Tropical Agriculture in Trinidad, an enterprise peculiarly associated with the late Lord Milner. A public appeal for funds for this all-important college has so far met with inadequate response, but I do hope that before many months have passed something more will be done to establish it on a sound financial basis. There is a vast field open for scientific work, and it is only if we can get the amount of money for this purpose that we can hope to achieve some measure of success in the solution of these problems."

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Cubes have remained steady at 35*s*. per cwt. but other kinds have declined slightly. Granulated realised 30*s*. and West Indian Crystallized 27*s*. 6*d*., on July 22nd. Futures for ordinary white sugar are firmer. Areas of sugar beet on the Continent are said to be growing well though many regions are in need of rain.

COTTON.—Weather in the American cotton belt still constitutes the dominant factor on the market. The continuance of the drought in Texas and the threat of similar conditions in Oklahoma have caused great anxiety, especially as it is stated that in certain areas the crop is already ruined and it is too late to replant. The seriousness of the situation may be gauged from the fact that Texas and Oklahoma comprise half the cotton area in the South. Mid-American closed at 13·48*d*. on July 23rd.

CACAO.—There has been a rally in cacao, Accras being quoted at 40*s*., and Grenada fine at 65*s*. Ceylon ordinary remains at 100*s*., while Trinidad Mid Red fell slightly to 75*s*. per cwt., all quotations being on July 22nd. Stocks are slightly smaller than at the same date last year.

COFFEE.—Following a brief rally, subsequent to June 17th, prices fell rather heavily, Costa Rica Middling fetching 160*s*., East Indian Mysore 140*s*., Kenya Good Middling 130*s*., and Brazil Santos 102*s*., each per cwt. on July 22nd. Stocks in bond totalling 370,000 cwt. are considered oppressive and attempts are being made to reduce them to more reasonable levels.

TEA.—The tendency for tea to decline continued until the end of June when prices began to rally. Averages on July 22nd were, Ceylon 19·13*d*., Indian 17·30*d*., and Java 13·00*d*., each per lb. Stocks of tea in London, expressed in units of a million lb., consist of 94 Indian, 36 Ceylon, 19 China and Japan and 17 Java and Sumatra.

SISAL AND HEMP.—America has been making heavy purchases of hemp with the result that exceptional prices are ruling in London, having advanced from £42 per ton on July 8th to £49 per ton on July 15th. Sisal advanced in a hesitating manner from £41 on July 8th to £43 on July 15th.

RUBBER.—The market has witnessed considerable fluctuations owing to agitation on the part of the manufacturers for an emergency release or the scrapping of the Stevenson Scheme. Spot sheet touched 4*s*. 6½*d*. at one time but uncertainty as to the future of the Scheme and the news of the release of 5,000 tons of old rubber from the East brought about a decline in prices. It is stated that a duty of 42 cents a pound has been paid on the 5,000 tons of rubber released but reliable details are lacking. Spot crepe and hard fine para spot both realised 4*s*. 3*d*. on July 23rd. Stocks in London on July 18th, adjusted by inspection, amounted to 4,050 tons.

COPRA.—Prices for Copra are recovering and fair sales are recorded, F.A.Q. Ceylon to London selling at £31 15*s*. per ton, Sun-dried Straits to Rotterdam £30 12*s*. 6*d*., and Straits to Marseilles £29 15*s*., on July 22nd.

PALM KERNELS.—After steadily declining in prices since the end of April palm kernels have risen rapidly during July and realised 22*s*. per cwt. ex-store Liverpool on July 22nd.

THE COCOA MARKET.

By Gillespie & Co., Inc., New York.

[*The following report has been received from Messrs. Gillespie & Co. of New York, Inc., who have very kindly consented to supply us with periodic reviews of the markets for the main tropical agricultural products. This report is dated July 23, 1925.*]

Following the firm and active market recorded here late last fall and early winter, a steady decline in prices took place. This decline was due to more abundant offers of cocoas from primary markets and a less urgent demand from manufacturing sources. The market did not reach a definite point of resistance until about the middle of April at which time the principal grades were selling at the following :

	cts.	
Accra	8½	ex dock.
Sanchez	7¾	do.
Bahia Superior ..	8¾	do.
Trinidad Estates ..	11	do.
La Guayra Caracas ..	11	do.

After that time a gradual improvement took place due to reduced offers and a better demand from local dealers. Contrary to general expectations manufacturers later became interested as buyers, with the result that prices advanced very rapidly under the impetus of competition between dealers and manufacturers. Highest prices were reached about a week ago when sales were made at the following prices :

	cts.	
Accra	11	ex dock.
Sanchez	10⅝	do.
Bahia Superior ..	11⅛	do.
Trinidad Estates ..	16	do.
La Guayra Caracas ..	15½	do.

Since then the market has turned slightly easier with sales effected at from ¼ to ½ cent below prices mentioned above.

New York spot stocks total about 260,000 bags of all grades but about 180,000 bags of these stocks consist of African grades.